



U.S. Fish & Wildlife Service

# Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement

*Comprehensive Conservation Plan*

*August 2012*



*Front cover:*

*Salt marsh at Great Bay National Wildlife Refuge*

Matt Poole/USFWS

*Karner blue butterfly*

USFWS

*Scarlet tanager*

Bill Thompson

*New England cottontail*

Linda Cullivan/USFWS

*American wigeon*

Bill Thompson

*Back cover:*

*Salt marsh at Great Bay National  
Wildlife Refuge*

Matt Poole/USFWS



*This blue goose, designed by  
J.N. "Ding" Darling, has become  
the symbol of the National Wildlife  
Refuge System.*

The U.S. Fish and Wildlife Service (Service) is the principal Federal agency responsible for conserving, protecting, and enhancing fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The Service manages the National Wildlife Refuge System comprised of over 150 million acres including 558 national wildlife refuges and thousands of waterfowl production areas. The Service also operates 70 national fish hatcheries and 81 ecological services field stations. The agency enforces Federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, administers the Endangered Species Act, and helps foreign governments with their conservation efforts. It also oversees the Federal Assistance Program which distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state wildlife agencies.

Comprehensive Conservation Plans (CCPs) provide long-term guidance for management decisions on a refuge and set forth goals, objectives, and strategies needed to accomplish refuge purposes. CCPs also identify the Service's best estimate of future needs. These plans detail program levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. CCPs do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

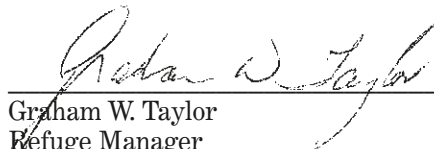


**U.S. Fish & Wildlife Service**

# **Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement**

## *Comprehensive Conservation Plan August 2012*

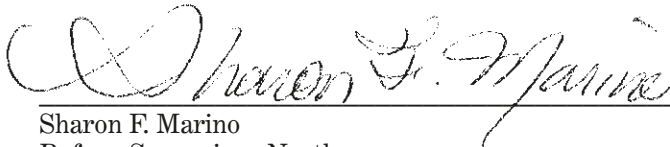
Submitted by:



Graham W. Taylor  
Refuge Manager  
Parker River National Wildlife Refuge

7/27/12

Concurrence by:



Sharon F. Marino  
Refuge Supervisor, North  
National Wildlife Refuge System, Region 5

8/2/2012

**ACTING**



Scott B. Kahan  
Assistant Regional Director  
National Wildlife Refuge System, Region 5

8/3/12

Approved by:



Wendi Weber  
Regional Director, Region 5  
U.S. Fish and Wildlife Service

29 Aug 2012

**Acting**



## U.S. Fish & Wildlife Service

# Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement

## *Comprehensive Conservation Plan* *August 2012*

### **Vision Statement**

Great Bay National Wildlife Refuge will be a treasured cornerstone in protecting and restoring the Great Bay Estuary's unique and significant ecological and cultural resources, which are unparalleled in New England. The estuary's shallow tidal waters will teem with a rich diversity of aquatic resources, from oysters and eelgrass beds, to healthy populations of migratory fish. The refuge's oak-hickory forests, grasslands, shrublands, and freshwater ponds will support a bounty of wildlife throughout the year. During winter, bald eagles will thrill refuge visitors as they taunt the many and diverse flocks of waterfowl and waterbirds foraging and resting in its quiet, protected waters. In spring, the refuge's forests, fields, and wetlands will fill with a symphony of bird songs and frog calls. The summer will reward visitors with the opportunity to view native fledgling birds, fawns, and other young of the year. During the fall, the refuge will host hundreds of migrating species ranging from waterfowl, to songbirds, bats, and butterflies, all needing safe haven in an increasingly urbanized landscape.

Visitors from throughout New England will travel to the refuge to become immersed in the sights and sounds of nature. The refuge will showcase innovative, science-based, adaptive management techniques and, coupled with exceptional outreach, education, and interpretive programs, help raise awareness and appreciation of the natural world and uphold the mission of the National Wildlife Refuge System. The refuge, in collaboration with partners, will work tirelessly to expand the protection and conservation of the Great Bay Estuary and its native habitats and wildlife for the benefit of the American people.

The Karner blue butterfly conservation easement lands in Concord, New Hampshire, will contribute to the recovery of the federally endangered Karner blue butterfly. Each spring, the flowers of native lupine plants growing among pitch pine on the easement lands will attract thousands of adult Karner blue butterflies to feed on nectar. During the summer, an abundance of Karner blue caterpillars will feed on the lupine leaves. As part of an extraordinarily dedicated partnership, the easement is a key link in the network of lands in the Concord area managed to help reverse the butterfly's decline and bring the species back from the brink of extirpation.





## U.S. Fish & Wildlife Service

# Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement

## *Comprehensive Conservation Plan August 2012*

### Summary

**Type of Action:** Administrative–Development of a Comprehensive Conservation Plan

**Lead Agency:** U.S. Department of the Interior, U.S. Fish and Wildlife Service

**Location:** Great Bay National Wildlife Refuge  
Newington, New Hampshire  
  
Karner Blue Butterfly Conservation Easement  
Concord, New Hampshire

**Administrative Headquarters:** Parker River National Wildlife Refuge  
Newburyport, Massachusetts

**Responsible Official:** Wendi Weber, Regional Director, Region 5

**For Further Information:** Nancy McGarigal, Natural Resource Planner  
Northeast Regional Office  
300 Westgate Center Drive  
Hadley, MA 01035  
(413) 253-8562  
[northeastplanning@fws.gov](mailto:northeastplanning@fws.gov)

This Comprehensive Conservation Plan for the 1,103-acre Great Bay National Wildlife Refuge (Great Bay Refuge; the refuge) and the 29-acre Karner blue butterfly conservation easement is the culmination of a planning effort involving New Hampshire State agencies, local partners, refuge neighbors, private landowners, and the local community. This CCP establishes 15-year management goals and objectives for wildlife and habitats, public use, and administration and facilities.

Under this plan, we will make improvements to the refuge's biological and public use programs. We will emphasize the management of specific refuge habitats to support focal species whose habitat needs benefit other species of conservation concern that are found in the Great Bay region. In particular, we will focus on habitat for priority migratory birds, such as waterfowl, waterbirds, shorebirds,

and forest-interior landbirds; for rare and declining species, such as the New England cottontail and tree bats; and for estuarine and aquatic species of concern, including shellfish and migratory fish. We plan to remove the Lower Peverly Pond Dam to restore stream habitat, while maintaining the dams at Upper Peverly Pond and Stubbs Pond to benefit a range of fish and wildlife. We will expand our conservation, research, and management partnerships to help restore and conserve the Great Bay estuarine ecosystem. We will enhance our visitor services programs by improving the main access to the refuge, creating new interpretive materials, expanding our existing volunteer program, and offering visitors more opportunities to learn about the refuge and the surrounding landscape. On the Karner blue butterfly conservation easement, we will continue to cooperate with partners on the recovery of this species, as well as installing new interpretive signs, offering interpretive walks, and enhancing our web-based information.

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## Chapter 1



USFWS

*Upper Peverly Pond*

# Purpose of, and Need for, Action

- Introduction
- Purpose of, and Need for, Action
- Service Policies, Legal Mandates, and Other Policies Guiding the Planning Process
- National and Regional Plans and Conservation Initiatives
- Refuge Purposes and Land Acquisition History
- Refuge Vision Statement
- Refuge Goals



## Introduction

The U.S. Fish and Wildlife Service (Service, we, our) established Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge) in 1992. It is located in the town of Newington in southeastern New Hampshire, on the eastern shore of the tidally influenced Great Bay Estuary. This 1,103-acre refuge includes 2 miles of rocky shoreline and is the largest parcel of protected land on the estuary (map 1.1). Great Bay Refuge was established to protect the natural diversity of fish, wildlife, and plants within its boundaries; protect federally listed species; preserve and enhance water quality and aquatic habitats; and fulfill the U.S.'s international treaty obligations relating to fish and wildlife resources. In the three decades prior to refuge establishment, the refuge lands were part of the former Pease U.S. Air Force (Air Force) Base. Despite this intensive land use, and its earlier use as a farm, the refuge has a rich diversity of habitat types including oak-hickory forests, grasslands, shrub thickets, freshwater and saltwater wetlands, and open water.

Great Bay Refuge also includes the 29-acre Karner blue butterfly conservation easement (conservation easement) in remnant pine barrens along the Merrimack River in Concord, New Hampshire (map 1.2). The conservation easement lies approximately 45 miles west of the refuge and abuts the Concord Airport. The conservation easement's pine barrens habitat is managed for the federally listed endangered Karner blue butterfly. It is part of a fragmented, but important, complex of remnant pine barrens that supports rare moths and butterflies. The habitat primarily consists of a mix of open pitch pine-scrub oak, pine-hardwood, and other shrubland.

## Purpose of, and Need for, Action

This final Comprehensive Conservation Plan (CCP) presents the management goals, objectives, and strategies that will guide the management decisions and actions on Great Bay Refuge over the next 15 years. It also helps New Hampshire natural resource agencies, our conservation partners, local communities, and the public understand our priorities and work with us to achieve common goals. In our professional judgment, this CCP helps us to best:

- Achieve the purposes, goals, and vision of the refuge.
- Contribute to the National Wildlife Refuge System's (Refuge System) mission.
- Adhere to Service's policies and other mandates.
- Address key issues and respond to public concerns.
- Incorporate sound principles of fish and wildlife science.

The *purpose* of a CCP is to provide strategic management direction on the refuge for the next 15 years that:

- Clearly states the desired future conditions of refuge habitat, wildlife, visitor services, staffing, and facilities.
- Provides state agencies, refuge neighbors, visitors, and partners with a clear explanation of the reasons for management actions.
- Ensures refuge management reflects the policies and goals of the Refuge System and legal mandates.
- Ensures the "compatibility" of current and future public use.
- Provides long-term continuity and direction for refuge management.

Map 1.1. Conservation Lands Surrounding Great Bay National Wildlife Refuge





Map 1.2. Karner Blue Butterfly Conservation Easement



- Provides direction for staffing, operations, maintenance, and annual budget requests.
- Best achieves, in our professional judgment, the goals for management of the refuge, as described under the section on “Refuge Goals” at the end of this chapter.

There are many reasons the refuge presently *needs* a CCP. First, the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (Pub. L. 105-57; 111 Stat. 1253) (Refuge Improvement Act) requires all national wildlife refuges to have a CCP in place by 2012 to help fulfill the mission of the Refuge System.

Second, Great Bay Refuge lacks a master plan to fulfill its obligations especially as administrative, environmental, economic, and social conditions have changed since the refuge was first established in 1992. Prior to 2005, the refuge employed an onsite refuge manager and an administrative assistant. In 2006, the Service made a decision to destaff Great Bay Refuge after budget cuts led to a new regional strategic staffing plan. Great Bay Refuge and the Karner blue butterfly conservation easement are now administered by the refuge manager at Parker River National Wildlife Refuge (Parker River Refuge) in Newburyport, Massachusetts.

Third, the environment around the refuge is changing and presenting new challenges and opportunities. In the last few decades, development has increased around the refuge. In response, land protection efforts have also increased. The refuge is an integral part of the network of conserved lands throughout the region. Great Bay Refuge has the potential to provide opportunities for environmental education and outreach that have not yet been fully realized. Also, we feel it is important to reevaluate refuge management in light of other landscape level threats, such as climate change and invasive species.

Finally, the CCP is needed to address key issues identified through the planning process by the public, partners, other agencies, and refuge staff. A primary concern is those issues that are adversely affecting the populations and habitats of fish, wildlife, and plants within the refuge. These key issues are described in detail in chapter 2 under the section titled, “Issues, Concerns, and Opportunities.”

This CCP is a valuable tool to help us articulate our management priorities to the State of New Hampshire (State) natural resource agencies, refuge partners, other conservation organizations, local communities, and the public. Through this CCP, we hope that we will strengthen our existing partnerships, and forge new ones, to help achieve our refuge purposes and goals and support the Refuge System mission.

This CCP has 5 chapters and 12 appendixes. Chapter 1 explains the purpose of, and need for, a CCP, and sets the stage for the rest of the document by:

- Defining our planning analysis area.
- Presenting the mission, policies, and mandates affecting the development of the plan.
- Listing the purposes for which the refuge was established and its land acquisition history.

- Identifying other conservation plans we used as references.
- Clarifying the vision and goals that drive refuge management.

Chapter 2, “The Planning Process,” describes our planning process, including public and partner involvement, and its compliance with the National Environmental Policy Act of 1969 (NEPA) regulations, and identifies public issues or concerns that surfaced during plan development.

Chapter 3, “Existing Environment,” describes the refuge’s physical, biological, and human environment.

Chapter 4, “Management Direction and Implementation,” presents the actions, goals, objectives, and strategies that will guide our decision-making and land management for the refuge. It also outlines the staffing and funding needed to accomplish that management.

Chapter 5, “Consultation and Coordination,” summarizes how we involved the public and our partners in the planning process, and credits the contributors to this plan. Public and partner involvement is vital for the future management of this refuge and all national wildlife refuges.

Twelve appendixes, a glossary with a list of acronyms and species’ scientific names, and a bibliography provide additional documentation and references to support our narratives and analysis. The appendixes include the following:

- Appendix A: Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement.
- Appendix B: Process for Establishing Focal Species and Priority Habitats for Great Bay National Wildlife Refuge System.
- Appendix C: Findings of Appropriateness and Compatibility Determinations.
- Appendix D: Wilderness Review for Great Bay National Wildlife Refuge.
- Appendix E: Refuge Operations Needs System (RONS) and Service Asset Maintenance Management System (SAMMS).
- Appendix F: Staffing Chart.
- Appendix G: Compliance with Section 7 of Endangered Species Act, Section 106 of the National Historic Preservation Act, and the Coastal Zone Management Act.
- Appendix H: Forest Health Assessment for Great Bay National Wildlife Refuge.
- Appendix I: Contaminants Review of Peverly Stream System.
- Appendix J: Proposed Refuge Headquarters/Visitor Contact Station.
- Appendix K: Summary of Public Comments and Service Responses on the Draft Comprehensive Conservation Plan and Environmental Assessment for Great Bay National Wildlife Refuge and the Karner Blue Butterfly Conservation Easement.
- Appendix L: Finding of No Significant Impact (FONSI).



## Service Policies, Legal Mandates, and Other Policies Guiding the Planning Process

### U.S. Fish and Wildlife Service

This section presents highlights of Service policy, legal mandates and regulations, and existing resource plans and conservation initiatives that directly influenced the development of this CCP.

The Service, part of the Department of the Interior (Department), administers the Refuge System. The mission of the Service is:

*“Working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.”*

Congress entrusts to the Service the conservation and protection of the following national natural resources, collectively referred to as “Federal trust resources:”

- Migratory birds.
- Federally listed endangered or threatened species.
- Migratory and interjurisdictional fish.
- Wetlands.
- Certain marine mammals.
- National wildlife refuges.

The Service also enforces Federal wildlife laws and international treaties on importing and exporting wildlife, assists states with their fish and wildlife programs, and helps other countries develop conservation programs.

The Service Manual, available online at: <http://www.fws.gov/policy/manuals> (accessed May 2012), contains the standing and continuing directives on fulfilling our responsibilities. The 600 series of the Service Manual addresses land use management, and sections 601-609 specifically address management of national wildlife refuges.

We publish special directives that affect the rights of citizens or the authorities of other agencies separately in the Code of Federal Regulations (CFR) (see 50 CFR 1–99 online at: <http://www.gpoaccess.gov/cfr/index.html> (accessed May 2012).

### The National Wildlife Refuge System

The Refuge System is the world’s largest network of public lands and waters set aside specifically for conserving wildlife and protecting ecosystems. From its inception in 1903, the Refuge System has grown to over 150 million acres, encompassing more than 550 national wildlife refuges and other units of the Refuge System, plus 37 wetland management districts. More than 40 million visitors annually hunt, fish, observe and photograph wildlife, or participate in environmental education and interpretive activities on these refuges.

The mission of the Refuge System is:

*“To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.”*  
—National Wildlife Refuge System Improvement Act of 1997

The fundamental focus of the Refuge System is wildlife conservation. The goals of the Refuge System are to:

- Fulfill our statutory duty to achieve refuge purposes and further the Refuge System mission.

- Conserve, restore, where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
- Perpetuate migratory bird, interjurisdictional fish, and marine mammal populations.
- Conserve a diversity of fish, wildlife, and plants.
- Conserve and restore, where appropriate, representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems.
- Foster understanding and instill appreciation of fish, wildlife, and plants, and their conservation, by providing the public with safe, high-quality, and compatible wildlife-dependent public uses including hunting, fishing, wildlife observation and photography, environmental education, and interpretation.

### **Refuge Planning and Management Guidance**

This Service policy (602 FW 1, 2, 3) establishes the requirements and guidance for Refuge System planning, including CCPs and step-down management plans. The policy further states that we will manage all refuges in accordance with an approved CCP that, when implemented, will help:

- Achieve refuge purposes.
- Fulfill the Refuge System mission.
- Maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System.
- Achieve the goals of the National Wilderness Preservation System and the National Wild and Scenic Rivers System.
- Conform to other applicable laws, mandates, and policies.

Service planning policy provides step-by-step directions and identifies the minimum requirements for developing all CCPs. Among these, is the requirement that either an environmental assessment (EA) or environmental impact statement (EIS) accompany, or be integrated, into each CCP. The EA we prepared for the Great Bay Refuge CCP process was integrated into the draft CCP/EA. We are also to review any existing special designation areas such as Wilderness Areas and Wild and Scenic Rivers designations, address the potential for any new special designations, conduct a wilderness review, and incorporate a summary of that review into each CCP (602 FW 3). Appendix D summarizes the results of our wilderness review. Based on our findings, Great Bay Refuge does not meet the minimum requirement for wilderness, and we are not recommending it for inclusion in the National Wilderness Preservation System. At this time, we do not see the potential for any other special designations on the refuge.

### **Policy on Maintaining Biological Integrity, Diversity, and Environmental Health**

Service policy (601 FW 3) provides guidance on maintaining and restoring the biological integrity, diversity, and environmental health of the Refuge System, including the protection of a broad spectrum of fish, wildlife, and habitat resources in refuge ecosystems. The policy provides the following definitions:

- Biological integrity is the “biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities.”

- Biological diversity is the “variety of life and its processes, including the variety of living organisms, the genetic differences among them, and communities and ecosystems in which they occur.”
- Environmental health is the “composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment.”

The policy provides refuge managers with a process for evaluating the best management direction to prevent additional degradation of environmental conditions and restore lost or severely degraded components of the environment. It also provides guidelines for dealing with external threats to a refuge’s biological integrity, diversity, and environmental health and its ecosystem.

### **Habitat Management Planning**

In collaboration with other refuges in the region, Great Bay Refuge staff prepared a draft Habitat Management Plan (HMP) in 2006 based on the guidelines set out in the Service’s HMP policy (620 FW 1). The HMP describes the process that the refuge used to identify priority resources of concern and to set habitat management priorities to benefit those resources. We used the habitat management goals, objectives, and strategies in the draft HMP as the biological foundation for this CCP. A final HMP will be developed after the completion of the CCP to ensure the habitat management actions in both plans are consistent. The final HMP will provide more detailed information on the timing, tools, and techniques we will use to achieve the refuge’s biological goals, objectives, and strategies. Appendix A lists the species of conservation concern at Great Bay Refuge identified during the HMP process. Appendix B details the process used to select these species of concern.

### **Policy on the Appropriateness of Refuge Uses**

Federal law and Service policy provide the direction and planning framework for protecting the Refuge System from inappropriate, incompatible, or harmful human activities and ensuring that all visitors can enjoy its lands and waters. This Service policy (603 FW 1) provides a national framework for determining appropriate refuge uses to prevent or eliminate those that should not occur in the Refuge System. It describes the initial decision process the refuge manager follows when first considering whether to allow a proposed use on a refuge. An appropriate use must meet at least one of the following four conditions:

1. The use is a wildlife-dependent recreational use, as identified in the Improvement Act.
2. The use contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act became law.
3. The use involves the take of fish or wildlife under state regulations.
4. The use has been found to be appropriate after concluding a specified findings process using the 10 specific criteria included in the policy.

Appendix C includes the findings of appropriateness for Great Bay Refuge. You may view the appropriateness policy on the Web at: <http://www.fws.gov/policy/603fw1.html> (accessed May 2011).

### **Policy on Compatibility**

This Service policy (603 FW 2) complements the appropriateness policy and provides guidance on how to prepare a compatibility determination. The refuge

manager first must find a use appropriate before undertaking a review of that use to determine if it is compatible. According to this policy, a compatible use is one "...that will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge." If the proposed use is found not appropriate, a compatibility determination is unnecessary and the use is not allowed. If the refuge manager finds a use appropriate, it is further evaluated through a compatibility determination. Other guidance in that chapter follows:

- The Refuge Improvement Act and its regulations require an affirmative finding by the refuge manager on the compatibility of a public use before we allow it on a national wildlife refuge.
- The act defines six wildlife-dependent uses that are to receive enhanced consideration on refuges: hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation.
- The refuge manager may authorize these six priority uses on a refuge when they are compatible and consistent with public safety.
- When the refuge manager publishes a compatibility determination, it will specify the required maximum reevaluation dates: 15 years for wildlife-dependent recreational uses; or, 10 years for other uses.
- However, the refuge manager may reevaluate the compatibility of a use at any time; for example, sooner than its mandatory date, or even before we complete the CCP process, if new information reveals unacceptable impacts or incompatibility with refuge purposes (603 FW 2.11, 2.12).
- The refuge manager may allow or deny any use, even one that is compatible, based on other considerations such as public safety, policy, or available funding.

Appendix C includes the compatibility determinations for Great Bay Refuge.

#### **Policy on Wildlife-dependent Public Uses**

This Service policy (605 FW 1) presents specific guidance about wildlife-dependent recreation programs within the Refuge System. We develop our wildlife-dependent recreation programs in consultation with state fish and wildlife agencies and stakeholder input based on the following criteria:

- Promotes safety of participants, other visitors, and facilities.
- Promotes compliance with applicable laws and regulations and responsible behavior.
- Minimizes or eliminates conflict with fish and wildlife population or habitat goals or objectives in an approved plan.
- Minimizes or eliminates conflicts with other compatible wildlife-dependent recreation.
- Minimizes conflicts with neighboring landowners.
- Promotes accessibility and availability to a broad spectrum of the American people.
- Promotes resource stewardship and conservation.



Les Brooks

*Baltimore oriole*

- Promotes public understanding and increases public appreciation of America's natural resources and our role in managing and conserving these resources.
- Provides reliable and/or reasonable opportunities to experience wildlife.
- Uses facilities that are accessible to people and blend into the natural setting.
- Uses visitor satisfaction to help to define and evaluate programs.

#### **Other Mandates**

While Service and Refuge System policies and each refuge's purpose(s) provide the foundation for management, national wildlife refuges are administered consistent with a variety of other Federal laws, executive orders, treaties, interstate compacts, and regulations including the following policies and laws on the conservation and protection of cultural resources. The "Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service" lists all natural and cultural resource laws and can be accessed at: <http://www.fws.gov/laws/Lawsdigest.html> (accessed May 2012).

#### *Cultural Resource Policy and Laws*

Federal laws require the Service to identify and preserve its important historic structures, archaeological sites, and artifacts. The NEPA mandates our consideration of cultural resources in planning Federal actions. The Refuge Improvement Act requires that the CCP identify the refuge's archaeological and cultural values. The following four Federal laws also cover historic and archaeological resources on national wildlife refuges:

- The Archaeological Resources Protection Act (ARPA) (16 U.S.C. § 470aa–470ll; Pub.L. 96–95), approved October 31, 1979 (93 Stat. 721). ARPA establishes detailed requirements for issuance of permits for any excavation for, or removal of, archaeological resources from Federal or Native American lands. It also establishes civil and criminal penalties for the unauthorized excavation, removal, or damage of those resources; for any trafficking in those resources removed from Federal or Native American land in violation of any provision of Federal law; and for interstate and foreign commerce in such resources acquired, transported, or received in violation of any state or local law.
- The Archaeological and Historic Preservation Act (AHPA) (16 U.S.C. § 469–469c; Pub.L. 86–523), approved June 27, 1960 (74 Stat. 220), as amended by Pub.L. 93–291 approved May 24, 1974 (88 Stat. 174). AHPA carries out the policy established by the Historic Sites Act (see below). It directs Federal agencies to notify the Secretary of the Interior whenever they find that a Federal or federally assisted licensed or permitted project may cause the loss or destruction of significant scientific, prehistoric, or archaeological data. The act authorizes the use of appropriated, donated, or transferred funds for the recovery, protection, and preservation of that data.
- The Historic Sites, Buildings, and Antiquities Act (16 U.S.C. § 461–462, 464–467; 49 Stat. 666) of August 21, 1935, popularly known as the Historic Sites Act, as amended by Pub.L. 89–249, approved October 9, 1965 (79 Stat. 971). This Historic Sites Act declares it a national policy to preserve historic sites and objects of national significance, including those located on refuges. It provides procedures for designating, acquiring, administering, and protecting these sites and objects. Among other things, National Historic and Natural Landmarks are designated under the authority of this act.



- The National Historic Preservation Act of 1966 (NHPA) (16 U.S.C. § 470–470b, 470c–470n), Pub.L. 89–665, approved October 15, 1966 (80 Stat. 915), and repeatedly amended. The NHPA provides for the preservation of significant historical features (buildings, objects, and sites) through a grant-in-aid program to the states. It establishes the National Register of Historic Places (National Register) and a program of matching grants under the existing National Trust for Historic Preservation (16 U.S.C. § 468–468d). This act establishes an Advisory Council on Historic Preservation, which became a permanent, independent agency in Pub.L. 94–422, approved September 28, 1976 (90 Stat. 1319). The act created the Historic Preservation Fund. It directs Federal agencies to take into account the effects of their actions on items or sites listed or eligible for listing on the National Register. The Margeson-Hawkridge-Loomis Estate (Margeson Estate) on Great Bay Refuge is on the National Register.

The Service also owns and cares for museum properties. The most common are archaeological, zoological, and botanical collections, and historical photographs, objects, and art. Each refuge maintains an inventory of its museum property. Our regional museum property coordinator in Hadley, Massachusetts, guides the refuges in caring for that property, and helps us comply with the Native American Grave Protection and Repatriation Act and Federal regulations governing Federal archaeological collections. Our program ensures that those collections will remain available to the public for learning and research.

## National and Regional Plans and Conservation Initiatives

To the extent possible, a CCP assists in meeting the conservation goals established in existing national and regional conservation plans, state fish and wildlife conservation plans, and other landscape-scale plans covering the same watershed or ecosystem in which the refuge resides. The following plans were consulted in the development of this CCP.

### Birds of Conservation Concern 2008 Report

The 1988 amendment to the Fish and Wildlife Conservation Act mandates the Service to “identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under Endangered Species Act of 1973 (ESA). *Birds of Conservation Concern 2008* (BCC) is the most recent effort to carry out this mandate (USFWS 2008). The overall goals of this report are to:

- Identify the migratory and nonmigratory bird species, beyond those already federally listed as threatened or endangered, that represent our highest conservation priorities.
- Encourage Federal, state, and private agencies to coordinate, develop, and implement integrated approaches for conserving and managing the birds deemed most in need of conservation.

BCC 2008 encompasses three distinct geographic scales:

1. National.
2. Service Regions.
3. Bird Conservation Regions (BCRs), as defined by the North American Bird Conservation Initiative (NABCI).

It is primarily derived from three major bird conservation plans:

1. The Partners in Flight (PIF) North American Landbird Conservation Plan.
2. The U.S. Shorebird Conservation Plan.
3. The North American Waterbird Conservation Plan.

All three of these bird conservation plans identify species of concern based on several factors, including population trends, threats, distribution, abundance, and relative density. These birds of conservation concern are incorporated into Appendix A, “Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement.”

The report is available online at: <http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/BCC2008/BCC2008.pdf> (accessed May 2012).

## **North American Bird Conservation Initiative**

NABCI brings together the individual landbird, shorebird, waterbird, and waterfowl plans described below into a coordinated effort to protect and restore all native bird populations and their habitats in North America. It uses BCRs to guide landscape-scale, science-based approaches to conserving birds and their habitats. Visit: <http://www.nabci-us.org/> (accessed May 2012) for more information on NABCI.

Great Bay Refuge is located in the New England/Mid-Atlantic Coast BCR (BCR 30). BCR 30 has the densest human population of any region in the country (<http://www.nabci-us.org/bcr30.htm>; accessed May 2012) (map 1.3). A draft BCR 30 plan was developed in September 2002 and a meeting in December 2004 at Cape May, New Jersey, produced a list of priority bird species and draft actions. An updated BCR 30 draft plan was developed in 2006 (Steincamp 2006). We used these documents, as well as information in the four additional bird conservation plans described below, to identify focal species and habitat management goals and objectives for the refuge. We list these species in Appendix A, “Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement.”

### **Partners in Flight Landbird Conservation Plans**

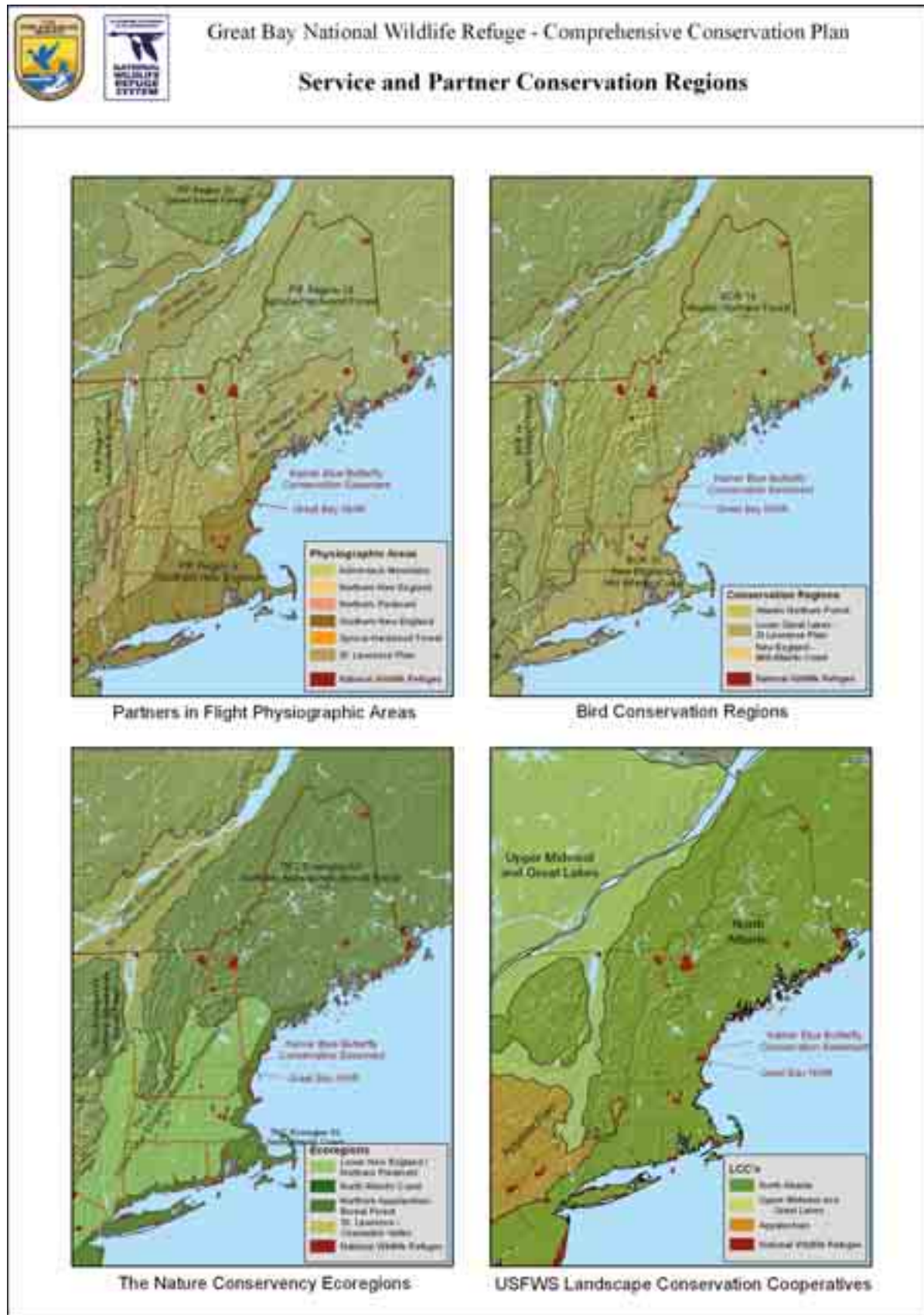
In 1990, PIF was conceived as a voluntary, international coalition of government agencies, conservation organizations, academic institutions, private industry, and other citizens dedicated to reversing the population declines of bird species and “keeping common birds common.” The foundation of PIF’s long-term strategy for landbird conservation is a series of scientifically and geographically based bird conservation plans.

Initially, PIF developed draft conservation plans within “physiographic areas.” PIF developed a set of science-based rules to evaluate the conservation status of all bird species using a species’ population size, distribution, population trend, threats, and regional abundance to objectively identify regional and continental conservation priorities. These rules were adapted and are now being used at the BCR level to identify bird conservation priorities and opportunities. Great Bay Refuge lies within PIF Area 09–Southern New England (Dettmers and Rosenberg 2000). The Karner blue butterfly conservation easement is within PIF Area 27–Northern New England (Hodgman and Rosenberg 2000) (map 1.3). We used these two plans to help create Appendix A, “Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement.”

### **U.S. Shorebird Conservation Plan and Northern Atlantic Regional Shorebird Plan**

The U.S. Shorebird Conservation Plan (Brown et al. 2001) is a partnership across the United States to ensure that stable and self-sustaining populations of all shorebird species are restored and protected. Collaborators include local, state, and Federal agencies, nongovernmental organizations, businesses, researchers, educators, and policymakers. The plan was closely coordinated with North American Waterfowl Management Plan and Joint Venture staff, as well as the

Map 1.3. Service and Partner Conservation Regions



PIF and North American Waterbird Plan teams, as they concurrently developed their revised national plans. These experts helped set conservation goals for each region of the country, identify critical habitat and research needs, and propose education and outreach programs to increase awareness of shorebirds and the threats they face.

The U.S. Shorebird Plan identified three primary objectives:

1. Develop a standardized, scientifically sound system for monitoring and studying shorebird populations that will provide practical information to researchers and land managers for shorebird habitat conservation.
2. Identify the principles and practices upon which local, regional, and national management plans can effectively integrate shorebird habitat conservation with multiple species strategies.
3. Design an integrated strategy for increasing public awareness and information concerning wetlands and shorebirds.

Regional plans, including the North Atlantic Regional Shorebird Plan, were developed as part of the overall strategy (Clark and Niles 2000). We used both the U.S. and North Atlantic Regional Shorebird Plans to develop the species of concern list (appendix A) and in considering the value of the refuge to migrating shorebirds. The national plan can be accessed at: <http://www.fws.gov/shorebirdplan/USShorebird.htm> (accessed May 2012) and the regional plan at: <http://www.fws.gov/shorebirdplan/regionalshorebird/regionalplans.htm> (accessed May 2012).

#### **North American Waterbird Conservation Plan**

This conservation plan for waterbirds is an independent partnership among individuals and institutions with interest and responsibility for conserving waterbirds and their habitats. The primary goal of the plan is to ensure that the distribution, diversity, and abundance of populations and habitats of breeding, migratory, and nonbreeding waterbirds are sustained or restored throughout the lands and waters of North America, Central America, and the Caribbean. The plan provides a framework for conserving and managing colonially nesting water-dependent birds and promotes continentwide planning and monitoring, national-state-provincial conservation action, regional coordination, and local habitat protection and management (Kushlan et al. 2002). You can access the plan online at: <http://www.pwrc.usgs.gov/nacwcp/nawcp.html> (accessed May 2012).

A partnership of organizations and individuals working to facilitate waterbird conservation in the Mid-Atlantic, New England, and Maritimes (MANEM) region of the U.S. and Canada has developed a regional waterbird conservation plan. Over 200 partners, comprising the MANEM Waterbird Working Group, have compiled and interpreted technical information on the region's waterbird populations and habitats, assessed conservation status of these natural resources, developed strategies to ensure the persistence of sustainable waterbird populations in the region, and identified near-term priorities. MANEM partners include wildlife managers, scientists, policymakers, educators, and funders.

The MANEM region consists of BCR 30 (New England/Mid-Atlantic Coast), BCR 14 (Atlantic Northern Forest), and Pelagic Bird Conservation Regions 78 (Northeast U.S. Continental Shelf) and 79 (Scotian Shelf). The MANEM Waterbird Conservation Plan is being implemented within the context and framework of the North American Waterbird Conservation Plan (<http://www.waterbirdconservation.org>; accessed May 2012).



Seventy-four waterbird species use habitats in MANEM for breeding, migrating, and wintering. Partners in 4 subregions of MANEM selected 43 focal species for immediate conservation action. In addition, 55 of MANEM's waterbirds are identified in state wildlife action plans as Species of Greatest Conservation Need. You can access information on MANEM Regional planning at: <http://www.fws.gov/birds/waterbirds/MANEM/> (accessed May 2012).

We used these waterbird plans to help develop objectives and strategies for goals 1 and 2, and to create Appendix A, "Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement."

#### **North American Waterfowl Management Plan: Atlantic Coast Joint Venture**

The North American Waterfowl Management Plan (NAWMP), signed by the U.S. and Canada in 1986 and by Mexico in 1994, provides a strategy to protect North America's remaining wetlands and to conserve waterfowl populations through habitat protection, restoration, and enhancement (USFWS and CWS 1986). The plan was updated in both 1998 and 2004 with an emphasis on strengthening its biological foundation, using a landscape planning approach, and expanding partnerships (USFWS and CWS 2004). Implementation of this plan is accomplished at the regional level within 16 joint venture areas in the U.S. and Canada. Partnerships involve Federal, state, and local governments; Tribal nations; local businesses; conservation organizations; and individual citizens for the purpose of protecting habitat. By 2004, NAWMP partners had invested more than \$3.2 billion to protect, restore, or enhance more than 13.1 million acres of habitat. More information on the NAWMP is available at: <http://www.fws.gov/birdhabitat/nawmp/nawmphp.htm> (accessed May 2012).

Great Bay Refuge lies within the Atlantic Coast Joint Venture (ACJV), one of the original joint ventures formed under the NAWMP. The ACJV was initially focused on protecting and restoring habitat for the American black duck and other waterfowl species in the United State's Atlantic Coast region. While maintaining this strong focus on waterfowl, the ACJV mission has evolved to include the conservation of habitats for all birds. The ACJV is working on integrated planning efforts in eight BCRs. Focus areas, which are specific, important geographic areas with joint venture regions, were identified and mapped for waterfowl and are being developed for other migratory birds within each BCR. These focus areas are discrete and distinguishable habitats or habitat complexes that are regionally important for one or more priority waterfowl species during one or more life history stages.

The Great Bay Estuary is a major wintering area for American black duck, and supports over 80 percent of all waterfowl populations wintering in New Hampshire. The area has been recognized as a waterfowl focus area in the ACJV Waterfowl Implementation Plan. Visit: <http://www.acjv.org> (accessed May 2012) for more information on the ACJV. We used this waterfowl to help develop to create Appendix A, "Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement."

#### **The State of New Hampshire's Birds: 2009**

This report provides an overview of the conservation status of New Hampshire's bird species, including their population trends, the major threats they face, and proposed strategies for their conservation (Hunt 2009). Overall, the report finds that nearly 47 percent of the 186 birds species in New Hampshire are declining, particularly grassland, shrubland, and ground-nesting forest species. For an additional 38 percent of species, too little information exists to determine trends. The major threats to the conservation of New Hampshire's birds identified in



the report include forest fragmentation; conversion of natural habitats to urban, commercial, and residential development; loss of late successional forest; climate change; and impacts to breeding, migration, and wintering habitats outside of the region. To counteract declining trends and reduce these threats, the report suggests six major strategies:

1. Improve and enhance monitoring of species of concern.
2. Maintain intact forests.
3. Prioritize conservation of early successional habitats.
4. Protect sensitive habitats by minimizing human disturbances.
5. Work at a regional scale.

We used this report to help create Appendix A, “Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement.”

### **Karner Blue Butterfly Recovery Plan**

The Karner blue butterfly formerly occurred in a band extending across 12 states from Minnesota to Maine, as well as Ontario, Canada. Currently, the species only occurs in seven states: Minnesota, Wisconsin, Indiana, Michigan, New York, New Hampshire, and Ohio. Currently, Wisconsin and Michigan support the greatest number of Karner blue butterflies and habitat sites. The majority of the populations in the remaining states are small and several are at risk of extirpation from habitat degradation or loss. Based on the decline of the Karner blue butterfly across its historic range, it was listed as federally endangered in 1992. Since listing, two populations have been extirpated and are being reintroduced to Concord, New Hampshire, and West Gary, Indiana. A third population is being reintroduced to Ohio (USFWS 2003).

The final recovery plan for the species was prepared in September 2003 (USFWS 2003). The objective of the recovery plan is to restore viable populations of Karner blue butterflies across the species extant range so that it can be reclassified from federally endangered to threatened. The long-range goal is to remove the species from the Federal list of endangered and threatened wildlife and plants. An update to the recovery plan was added in February 2011 to include a new potential recovery unit, the Michigan Oak Openings Unit. Both the 2003 plan and its update can be accessed at: <http://www.fws.gov/midwest/endangered/insects/kbb/index.html> (accessed May 2012).

### **Additional Background on the Karner Blue Butterfly**

The Karner blue butterfly is dependent on wild lupine—its only known larval food plant—and on nectar plants. These plants historically occurred in savanna and barrens habitats typified by dry sandy soils, and now occur in remnants of these habitats. The primary factor limiting Karner blue butterfly recovery is loss of habitat due to development and increased forest canopy closure due to natural succession.

By 2003, no native Karner blue butterfly populations remained in New England. The last native New England population occurred in the Concord Pine Barrens in Concord, New Hampshire, and was extirpated in 2000. This last population, which existed in a powerline right-of-way and along the grassy safeways of the Concord Airport Industrial Park, had declined from 3,700 estimated butterflies in 1983, to 219 butterflies in 1991, and to less than 50 in 1994. This decline made this site’s population at extreme risk for extinction (Peteroy 1998). A reintroduction program was started in 2001 in Concord with a donor population from the Saratoga Airport in New York. For 5 years in a row (2005 to 2009) biologists have observed and documented Karner blue butterflies surviving on their own in the wild at the Concord pine barrens. The Karner blue butterfly

## New England Cottontail Spotlight Action Plan

conservation easement, administered by Great Bay Refuge, is central to this success (see discussion in this chapter under the section “Refuge Purposes and Land Acquisition History). New Hampshire Fish and Game (NHFG) coordinates habitat management, lupine propagation and planting, and captive rearing and introduction of the Karner blue butterfly on the conservation easement.

Great Bay Refuge is within the historic range of New England cottontail, the only rabbit species native to New England. The New England cottontail is listed as endangered in the State of New Hampshire and is also currently a candidate species for listing on the Federal list of threatened and endangered species due to population decline. Candidate species are plant and animal species for which the Service has sufficient information on biological vulnerability and threats to support a proposal to list as endangered or threatened, but that have yet to be listed due to higher priorities. Since candidate species are not yet listed, there is still the opportunity that proactive conservation actions can prevent the need for listing.

The New England Cottontail Spotlight Action Plan identifies the threats to New England cottontails, goals and actions to reduce and mitigate these threats, and measures to monitor the success of the plan (USFWS 2009). The plan identifies habitat fragmentation and habitat loss as the major threats to New England cottontail recovery. The species is dependent upon early successional habitats, such as old fields, shrub thickets, young regenerating forests, and other shrubby areas. These types of early successional habitats are currently declining throughout New England as they naturally transition to forest. Human development has also eliminated and fragmented habitat for the New England cottontail. Although there are currently no known occurrences of New England cottontails on the refuge, there are opportunities on the refuge to create and maintain the early successional habitats that benefit the species, as well as other shrub-dependent wildlife (Arbuthnot 2008).

The Spotlight Action Plan is available online at: <http://www.fws.gov/northeast/endangered/pdf/NE%20Cottontail%20SSAP.pdf> (accessed May 2011).

## U.S. Fish & Wildlife Service Fisheries Program, Northeast Region Strategic Plan 2009–2013

The Service’s Fisheries Program is committed to working with partners to:

- Protect the health of aquatic habitats.
- Restore fish and other aquatic resources.
- Provide opportunities to enjoy the many benefits of healthy aquatic resources.

The Service’s Fisheries Programs’ primary focus is on maintaining healthy, self-sustaining populations of coastal, anadromous, and interjurisdictional fish, as well as other threatened and endangered aquatic animal species.

In 2002, the Fisheries Program completed a strategic vision document: “Conserving America’s Fisheries, U.S. Fish and Wildlife Service Fisheries Program Vision for the Future.” This document includes national goals, objectives, and action items on a national scale.

## Northeast Regional Fisheries Program and Regional Fisheries Strategic Plan

In the Service’s Northeast Region, fishery management offices and national fish hatcheries work with states and other partners to restore and protect a variety of fish and other aquatic species. The Northeast Regional Fisheries Program Strategic Plan is an extension of the national document and describes more

specifically the tactics to be implemented by the Northeast Region to fulfill the national goals and objectives. The current strategic plan covers 2009 to 2013 and can be viewed at: <http://www.fws.gov/northeast/fisheries/> (accessed May 2012) (USFWS 2009a).

In addition to the strategic plan, the Fisheries Program also identified and ranked the level of conservation concern of fish and other aquatic species by hydrologic unit. We used this ranking and have consulted with the Fisheries Program staff in developing aquatic objectives and strategies under goal 2, and in creating Appendix A, “Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement.”

### **North American Bald Eagle Management Guidelines**

In July 2007, the Service issued a final ruling to officially remove the bald eagle from the Federal list of endangered and threatened species due to its successful recovery throughout its range in the lower 48 States. The bald eagle continues to be protected by the Bald and Golden Eagle Protection Act (Eagle Act) and the Migratory Bird Treaty Act (MBTA). The Service developed the National Bald Eagle Management Guidelines to advise landowners, land managers, and others who share public and private lands with bald eagles, when and under what circumstances the protective provisions of the Eagle Act may apply to their activities (USFWS 2007).

These guidelines are intended to help people minimize such impacts to bald eagles, particularly where they may constitute “disturbance,” which is prohibited by the Eagle Act. These guidelines:

1. Publicize the provisions of the Eagle Act that continue to protect bald eagles, in order to reduce the possibility that people will violate the law.
2. Advise landowners, land managers, and the general public of the potential for various human activities to disturb bald eagles.
3. Encourage additional nonbinding land management practices that benefit bald eagles.

The document is intended primarily as a tool for landowners and planners who seek information and recommendations regarding how to avoid disturbing bald eagles. You can view these management guidelines at: <http://www.fws.gov/pacific/ecoservices/documents/NationalBaldEagleManagementGuidelines.pdf> (accessed May 2012). We referred to these guidelines as we developed management objectives and strategies for bald eagles.

### **The Land Conservation Plan for New Hampshire’s Coastal Watersheds**

In 2006, The Nature Conservancy (TNC), Society for the Protection of New Hampshire Forests (SPNHF), and the Rockingham and Strafford Regional Planning Commissions published “*The Land Conservation Plan for New Hampshire’s Coastal Watersheds*” (Zankel et al. 2006). New Hampshire’s coastal watersheds span 990 square miles (approximately 633,000 acres) and 46 towns. The plan identified 75 conservation focus areas that comprise over 190,000 acres of the coastal watersheds that are of exceptional significance for living resources and water quality.

Each conservation focus area is comprised of a core area that contains the primary natural features and habitat for which the focus area was identified. Some focus areas also include a “supporting natural landscape,” which is comprised of natural lands that helps safeguard the core area while also providing habitat for many common species.

A portion of Great Bay Refuge is located within the Fabyan Point Conservation Focus Area. This area was included as a focus area in the coastal plan because it has the following ecological features:

- Estuarine shoreline along Great Bay.
- Presence of tidal rivers, including Peverly Brook.
- Extensive salt marsh.
- Presence of rare plants and animals, including large bur-reed, salt marsh sparrow, osprey, and purple martin.
- Significant wildlife habitats including grasslands and tidal marsh.
- Mesic Appalachian oak-hickory forest, an exemplary natural community.
- Presence of prime farmland soils.

### New Hampshire Wildlife Action Plan

In 2002, Congress created the State Wildlife Grant Program (SWG), and appropriated \$80 million in state grants. The purpose of the program is to help state and Tribal fish and wildlife agencies conserve fish and wildlife species of greatest conservation need. The funds appropriated under the program are allocated to each state according to a formula that takes into account its size and population.

To be eligible for additional Federal grants, and to satisfy the requirements for participating in the SWG program, each state was charged with developing a statewide “Comprehensive Wildlife Conservation Strategy” and submitting it to the National Advisory Acceptance Team by October 1, 2005. Each plan must address eight required elements and identify and focus on “species of greatest conservation need.” Each plan must also address the “full array” of wildlife and wildlife-related issues, and how to “keep common species common.”

In response to that charge, NHFG, with support from partners, developed the “New Hampshire Wildlife Action Plan” (NHWAP) (NHFG 2005). NHFG is the chief agency responsible for the implementation and revision of the NHWAP. The plan creates a vision for conserving New Hampshire’s wildlife and encourages other states, Federal agencies, and conservation partners to think strategically about their individual and coordinated roles in prioritizing conservation.

The NHWAP helps supplement the information we gathered on species and habitat occurrences and their distribution in our area analysis, and helps us identify conservation threats and management strategies for species and habitats of conservation concern in the CCP. The development of this plan involved invaluable input from experts, partners, and the public. We used the NHWAP in developing our list of species of concern in appendix A, and the management objectives and strategies for goals 1 through 3.

You may view the NHWAP at: [http://www.wildlife.state.nh.us/Wildlife/wildlife\\_plan.htm](http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm) (accessed May 2012).



Phil Delphey/USFWS

*Karner blue butterfly*

### Piscataqua Region Estuaries Partnership's Comprehensive Conservation and Management Plan

The Piscataqua Region Estuaries Partnership (PREP) is part of the U.S. Environmental Protection Agency’s (EPA) National Estuaries Program. This program is a joint program between local, state, and Federal agencies and was established under the Clean Water Act. Its goal is to protect and enhance nationally significant estuarine resources. Currently, there are 28 estuaries along the coast of the United States in the National Estuaries Program.

PREP includes the Great Bay Estuary watershed and the Hampton-Seabrook Estuary watershed and covers 52 communities in New Hampshire and Maine. Its major focuses are Great Bay, Little Bay, and the Hampton-Seabrook areas. PREP strives to:

- Improve the water quality and overall health of New Hampshire's estuaries.
- Support regional development patterns that protect water quality, maintain open spaces and important habitat, and preserve estuarine resources.
- Track environmental trends through the implementation of a long-term monitoring program to assess indicators of estuarine health; and,
- Develop broad-based popular support for the implementation of the management plan by encouraging involvement of the public, local government, and other interested parties in its implementation.

PREP's priorities were established by local stakeholders and include water quality improvements, shellfish resources, land protection, and habitat restoration. Projects addressing these priorities are undertaken throughout New Hampshire and southern Maine's coastal watersheds. PREP receives its funding from the EPA and is administered by the University of New Hampshire (UNH).

PREP's Comprehensive Conservation and Management Plan (CCMP) for the region's estuaries was completed in 2000 and updated in 2010 (PREP 2010). The management plan outlines key issues related to the management of New Hampshire's estuaries and proposes strategies to preserve, protect, and enhance the State's estuarine resources.

#### **Great Bay National Estuarine Research Reserve**

The National Estuarine Research Reserve System (Reserve System) is a network of 28 areas protected for long-term research, water quality monitoring, education, and coastal stewardship. Established by the Coastal Zone Management Act of 1972, as amended, the Reserve System is a partnership program between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states. NOAA provides funding, national guidance, and technical assistance. Each reserve is managed by a lead state agency or university, with input from local partners.

The Great Bay National Estuarine Research Reserve (GBNERR) was designated in 1989 and now encompasses 10,235 acres. Great Bay Refuge lies within the reserve's boundaries and benefits from the research, education, and outreach conducted by reserve staff. The NHFG is the lead agency. In 1993, the Great Bay Discovery Center (formerly known as Sandy Point) was constructed on the shores of Great Bay Estuary in Greenland, New Hampshire. It serves as the conservation-education headquarters for the GBNERR. The reserve's primary purpose is to promote the wise use and management of the Great Bay Estuary (<http://www.greatbay.org/index.htm>; accessed May 2012).

#### **New Hampshire Coastal Program**

The New Hampshire Department of Environmental Services (NHDES) administers the State's Coastal Program. The New Hampshire Coastal Program (NHCP) creates and sustains partnerships with local, State, and Federal agencies, as well as businesses and nonprofit groups to complete planning, restoration, and education projects. The mission of the NHCP is to "balance the preservation of natural resources of the coast with the social and economic needs of this and succeeding generations."



To accomplish its mission, the program focuses on:

- Preventing and reducing coastal pollution.
- Providing public access to coastal lands and waters.
- Fostering community stewardship and awareness of coastal resources.
- Protecting and restoring coastal natural resources.
- Encouraging a viable economy with adequate infrastructure.

In 1982, New Hampshire received Federal approval from NOAA for the Ocean and Harbor Segment of its Coastal Program, which incorporated areas in proximity to the Atlantic Ocean and the lower Piscataqua River. In 1988, the NHCP received approval from NOAA to expand its boundaries to cover all near shore areas under tidal influence, including the lands that border Great Bay and Little Bay Estuaries and several tidal rivers. The NHCP received approval from NOAA again in 2004 to expand its inland boundary to encompass the jurisdictional boundary of the 17 municipalities along New Hampshire's tidal waters.

The NHCP is responsible for administering the Federal consistency provision of the Coastal Zone Management Act in New Hampshire. NHCP reviewed the draft CCP/EA and found that our proposed management is consistent, to the maximum extent practicable, with its enforceable policies and all State coastal management requirements. Their letter concurring with our Federal consistency determination is included as appendix G to this CCP.

For more information on the NHCP, please visit: <http://des.nh.gov/organization/divisions/water/wmb/coastal/index.htm> (accessed May 2012).

### **Partners in Amphibian and Reptile Conservation**

Partners in Amphibian and Reptile Conservation (PARC) was created in response to the increasing, well-documented national declines in amphibian and reptile populations. PARC members come from state and Federal agencies, conservation organizations, museums, the pet trade industry, nature centers, zoos, power companies, universities, reptile and amphibian organizations, research laboratories, forest industries, and environmental consultants. Its five geographic regions—Northeast, Southeast, Midwest, Southwest, and Northwest—focus on regional and national reptile and amphibian conservation challenges.

The National State Agency Herpetological Conservation Report, a summary report sponsored by PARC, provides a general overview of each state wildlife agency's support for reptile and amphibian conservation and research through September 2004. Each state report was compiled in cooperation with its agency's lead biologist on reptile and amphibian conservation. The purpose is to facilitate communication among state agencies and partner organizations throughout the PARC network to identify and address regional and national priorities. The State of New Hampshire is available online at: <http://www.parcplace.org/documents/PARCNationalStates2004.pdf> (accessed May 2011). We used the New Hampshire plan in developing objectives and strategies for goals 1 and 2 and in developing Appendix A, "Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement."

### **The Service's Climate Change Strategy, "Rising to the Urgent Challenge" (USFWS 2010)**

Accelerating climate change will affect our nation's fish, wildlife, and plant resources in profound ways. While many species will continue to thrive, some populations may decline and in some instances, go extinct. Others will survive in the wild only through direct and continuous intervention by managers. The challenge of climate change requires the Service, its employees, and partners to work with determination, creativity, and commitment to conserve the nation's natural resources.



In response to Secretarial Orders #3226, “Evaluating Climate Change Impacts in Management Planning” (January 19, 2001) and #3289, “Addressing the Impacts of Climate Change on America’s Water, Land, and Other Natural and Cultural Resources” (February 22, 2010), the Service developed the strategic plan, “Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change,” to address climate change. The plan establishes a basic framework for the Service’s work as part of the conservation community to help ensure the sustainability of fish, wildlife, plants, and habitats in the face of accelerating climate change. It also details specific steps the Service will take over the next 5 years to implement the strategic plan (USFWS 2010). The plan can be accessed online at: <http://www.fws.gov/home/climatechange/strategy.html> (accessed May 2012).

The strategic plan has six guiding principles:

1. We will continually evaluate our priorities and approaches, make difficult choices, take calculated risks, and adapt to climate change.
2. We will commit to a new spirit of coordination, collaboration, and interdependence with others.
3. We will reflect scientific excellence, professionalism, and integrity in all our work.
4. We will emphasize the conservation of habitats within sustainable landscapes, applying our Strategic Habitat Conservation framework.
5. We will assemble and use state-of-the-art technical capacity to meet the climate change challenge.
6. We will be a leader in national and international efforts to address climate change.

The plan also lists three key strategies to address climate change: adaptation, mitigation, and engagement. Below we provide a detailed description of these strategies:

**Adaptation** is an, “adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (<http://www.ipcc.ch/index.htm> [May 2012]). In the strategic plan, adaptation refers to planned management actions the Service will take to reduce the impacts of climate change on fish, wildlife, and their habitats. Adaptation forms the core of the Service’s response to climate change and is the centerpiece of our strategic plan. This adaptive response to climate change will involve strategic conservation of terrestrial, freshwater, and marine habitats within sustainable landscapes.

**Mitigation** is “human intervention to reduce the sources or enhance the sinks of greenhouse gases” (<http://www.ipcc.ch/index.htm> [May 2012]). Mitigation involves reducing our “carbon footprint” by using less energy, consuming fewer materials, and appropriately changing our land management practices. Mitigation is also achieved through biological carbon sequestration, which is a process in which carbon dioxide (CO<sub>2</sub>) from the atmosphere is taken up by plants through photosynthesis and stored as carbon in biomass (e.g., tree trunks and roots). Sequestering carbon in vegetation, such as native hardwood forests or grassland, can often restore or improve habitat and directly benefit fish and wildlife.

Engagement involves reaching out to Service employees; local, national, and international partners in the public and private sectors; key stakeholders; and the general public to find solutions to the challenges to fish and wildlife conservation posed by climate change.

The Association of Fish and Wildlife Agencies has developed guidance for states as they update and implement their respective wildlife action plans (AFWA 2009). This publication, “Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans and Other Management Plans,” also includes strategies that will help conserve fish and wildlife species and their habitats and ecosystems as climate conditions change. The broad spatial and temporal scales associated with climate change suggest that management efforts that are coordinated on at least the regional scale will likely lead to greater success. The Service will work with our state partners, among others, on meeting the climate change challenge.

The Service’s Climate Change Web site, <http://www.fws.gov/home/climatechange/strategy.html> (accessed May 2012), provides detailed information on the priority actions the Service is taking through 2011 to begin to implement the strategic plan.

### **North Atlantic Landscape Conservation Cooperative**

Landscape Conservation Cooperatives (LCCs) are a network of conservation science and management partnerships across the U.S. and its international borders. LCCs were created in response to the unprecedented level of large-scale pressures on natural systems (e.g., land use pressures, habitat loss and fragmentation, invasive species, and climate change) and the need for agencies and organizations to work together to find long-term solutions to these threats. Each LCC is comprised of Federal and state agencies, Tribes, universities, and public and private organizations, collectively working to sustain America’s lands, waters, wildlife, and cultural resources. By functioning as an interdependent network, LCCs are able to accomplish more together than any single agency or organization alone. LCC partners use their combined resources to collaboratively:

- Identify common science needs, conservation goals, and priorities.
- Develop science-based tools and solutions to meet shared conservation goals.
- Support biological planning, conservation design, and adaptive management.
- Evaluate the effectiveness of scientific information and conservation actions (<http://www.fws.gov/science/shc/lcc.html>; accessed May 2012).

Great Bay Refuge lies in the North Atlantic LCC, which covers portions of 12 Northeastern States and the District of Columbia (map 1.3). The North Atlantic LCC’s 2009 Development and Operations Plan identified priority actions for the LCC and included a preliminary list of conservation priority species and habitats, many of which occur on the refuge. The LCC partner group continues to update and refine its priorities, and is working on a representative species list to help focus inventories and monitoring. Refuge staff will stay attentive to new developments arising from the LCC partnership and adapt management accordingly. For more information on the North Atlantic LCC and its current conservation priorities, visit: <http://www.fws.gov/northeast/science/nalcc.html> (accessed May 2012).

## Refuge Purposes and Land Acquisition History

### Refuge Purposes

The purposes for Great Bay Refuge are derived from public law (Public Law 102-154, Section 319(d) Department of the Interior and Related Agencies Appropriations Bill, 1992). This act by Congress describes the terms of the land transfer of the Pease Air Force Base in New Hampshire, to the Department of the Interior as a national wildlife refuge. The act also states that the Secretary of the Air Force retains responsibility for any hazardous substance which may be found on the property. The following purposes were established for this refuge:

- To encourage the natural diversity of plant, fish, and wildlife species within the refuge, and to provide for their conservation and management.
- To protect species federally listed as endangered or threatened or identified as candidates pursuant to the Endangered Species Act of 1973.
- To preserve and enhance the water quality of aquatic habitat within the refuge.
- To fulfill the international treaty obligations of the U.S relating to fish and wildlife.

### Acquisition History

Currently, Great Bay Refuge encompasses 1,103 acres (map 1.1), with Federal jurisdiction to the mean high waterline. In 1992, the Department of Defense transferred the original 1,054 acres of the refuge to the Service. The transfer occurred because the Pease Air Force Base was one of 89 U.S. military installations closed by the Base Closure and Realignment Act (Public Law 100-526). Although the refuge was dedicated in October of 1992, it was not officially opened to public access until 1996.

In 2003, the refuge acquired an additional 33 acres on Fabyan Point in fee title from a willing seller. Fabyan Point is a spit of land on Great Bay located south of the main portion of the refuge. The parcel was bought by the Service using Land and Water Conservation Funds (LWCF) which is a funding source appropriated



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*Hooded merganser*

annually by Congress that comes from a variety of revenue sources rather than general tax revenues. At the time of sale, seven tenants living on the parcel were relocated with compensation and their cottages still remain on the property. This acquisition included a right-of-way access in common with others on Fabyan Point Road off of McIntyre Road.

For any future land acquisitions, the Service's policy is to acquire land only from willing sellers at fair market value. Landowners may sell their land to the Service in fee title (outright), or they may sell development rights through a conservation easement. Private landowners within an approved refuge acquisition boundary who do not wish to sell will continue to retain full control of their property and their rights to use it, in compliance with applicable local, state, and Federal regulations.

### **Karner Blue Butterfly Conservation Easement**

Great Bay Refuge also administers the 29-acre Karner blue butterfly conservation easement in Concord, New Hampshire. This conservation easement was established in July 1992 through a cooperative agreement between the Service, the city of Concord, the Concord Community Development Corporation (CCDC), the U.S. Postal Service, and TNC. The Service's conservation easement, located in the Concord Airport Industrial Park, consists of two adjacent parcels that were donated to the Service by the city of Concord following an exchange of airport land between the city of Concord and the nonprofit CCDC. The conservation easement was established to protect a small remnant pine barren community in Concord that is habitat for the federally listed endangered Karner blue butterfly and other rare Lepidoptera (moths and butterflies). TNC agreed to serve as a managing partner with the Service while the city of Concord and CCDC agreed to cooperate in the research and management of Karner blue butterfly habitat in management agreement areas. Since 2000, NHFG has conducted onsite habitat management of the conservation easement.

### **Refuge Vision Statement**

Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge) will be a treasured cornerstone in protecting and restoring the Great Bay Estuary's unique and significant ecological and cultural resources, which are unparalleled in New England. The estuary's shallow tidal waters will teem with a rich diversity of aquatic resources, from oysters and eelgrass beds, to healthy populations of migratory fish. The refuge's oak-hickory forests, grasslands, shrublands, and freshwater ponds will support a bounty of wildlife throughout the year. During winter, bald eagles will thrill refuge visitors as they taunt the many and diverse flocks of waterfowl and waterbirds foraging and resting in its quiet, protected waters. In spring, the refuge's forests, fields, and wetlands will fill with a symphony of bird songs and frog calls. The summer will reward visitors with the opportunity to view native fledgling birds, fawns, and other young of the year. During the fall, the refuge will host hundreds of migrating species ranging from waterfowl, to songbirds, bats, and butterflies, all needing safe haven in an increasingly urbanized landscape.

Visitors from throughout New England will travel to Great Bay Refuge to become immersed in the sights and sounds of nature. The refuge will showcase innovative, science-based, adaptive management techniques and, coupled with exceptional outreach, education, and interpretive programs, help raise awareness and appreciation of the natural world and uphold the mission of the National Wildlife Refuge System. The refuge, in collaboration with partners, will work tirelessly to expand the protection and conservation of the Great Bay Estuary and its native habitats and wildlife for the benefit of the American people.



The Karner blue butterfly conservation easement lands in Concord, New Hampshire, will contribute to the recovery of the federally endangered Karner blue butterfly. Each spring, the flowers of native lupine plants growing among pitch pine on the conservation easement lands will attract thousands of adult Karner blue butterflies to feed on nectar. During the summer, an abundance of Karner blue caterpillars will feed on the lupine leaves. As part of an extraordinarily dedicated partnership, the conservation easement is a key link in the network of lands in the Concord area managed to help reverse the butterfly's decline and bring the species back from the brink of extirpation.

## Refuge Goals

The purpose of the CCP is to provide the refuge with a 15-year strategic management plan, consistent with Service policies and legal mandates that will achieve the following five refuge goals. These goals were developed after consideration of refuge purposes, the Service and Refuge System missions, our vision for the refuge, and the mandates, plans, and conservation initiatives described above. These goals are intentionally broad, descriptive statements of purpose.

**Goal 1:** Perpetuate the biological integrity, diversity, and environmental health of estuarine and freshwater habitats on Great Bay Refuge to protect water quality and sustain native plant communities and wildlife, including species of conservation concern.

**Goal 2:** Perpetuate the biological integrity, diversity, and environmental health of upland and forested wetland habitats on Great Bay Refuge to sustain native plant communities and wildlife, including species of conservation concern.

**Goal 3:** Foster and maintain conservation, research, and management partnerships to promote protection and stewardship of the ecological resources of the Great Bay Estuary.

**Goal 4:** Promote enjoyment and awareness of Great Bay Refuge and Great Bay Estuary by providing high-quality, compatible wildlife-dependent public uses on refuge lands and on partner lands and waters around the refuge.

**Goal 5:** Contribute to the recovery of the federally endangered Karner blue butterfly and other rare Lepidoptera through the conservation, protection, and restoration of pine barrens habitat.



Matt Poole/USFWS

*Fall colors on the refuge*



## Chapter 2

Matt Poole/USFWS



*Great Bay shoreline*

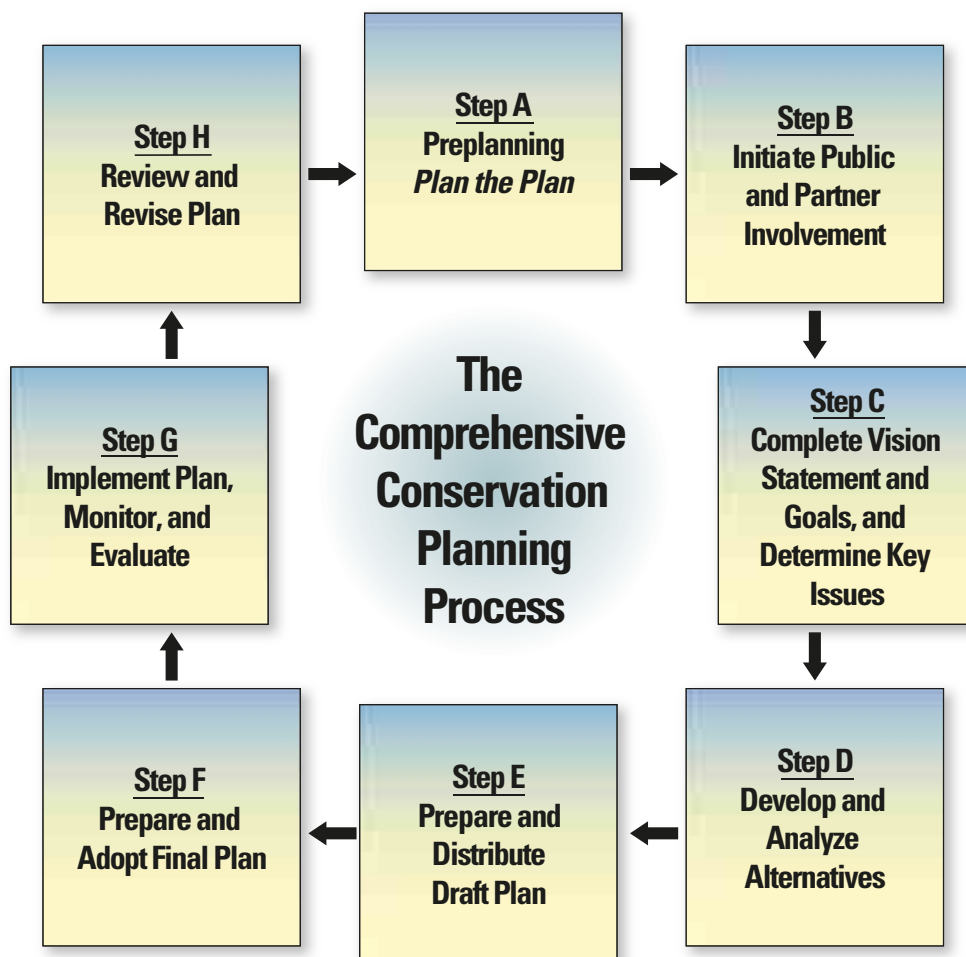
## The Planning Process

- The Comprehensive Conservation Planning Process
- Issues, Concerns, and Opportunities

## The Comprehensive Conservation Planning Process

Service policy (602 FW 3) establishes a comprehensive conservation planning process that also complies with NEPA (figure 2.1). The full text of the policy and a detailed description of the planning steps can be viewed at: <http://policy.fws.gov/602fw3.html> (accessed May 2012). We followed the process depicted below in developing the draft CCP/EA and this final CCP. Although the steps are described sequentially, the CCP planning and NEPA processes are iterative. It is normal to cycle through some steps more than once or to have several steps occurring simultaneously. The steps are described below in more detail and depicted in figure 2.1.

Figure 2.1 The Service's Comprehensive Conservation Planning Process



### Step A: Initial Planning

We began preparing a CCP for Great Bay Refuge in early 2009. Initially, we focused on collecting information on the refuge's natural and cultural resources and public use program. The CCP core team of refuge and regional office staff and two representatives from NHFG started meeting to discuss existing information, draft a vision statement, and prepare for the public scoping meeting and a technical meeting of State and Federal partners.

### Step B: Public Scoping

On June 17, 2009, we published a notice of intent in the *Federal Register* announcing that we were starting the CCP process for Great Bay Refuge.

We held a public scoping meeting on June 18, 2009, at the Newington Town Hall. We announced the location, date, and time for this meeting in local newspapers and through special mailings. Twenty-two people attended the meeting, which was held to let people know what the Service was doing to manage Great Bay Refuge, and to elicit their input on topics of interest to them about the refuge.

In June 2009, we also distributed a newsletter announcing the kick-off of the planning process. We followed that distribution late June with a mailing of issues workbooks. We distributed a workbook to everyone on our mailing list, to those who attended the public meeting, and to anyone who subsequently requested one. The purpose of the workbook was to collect ideas, concerns, and suggestions on important issues about refuge management. In the workbook, we asked the public to share what they valued most about the refuge, their vision for the future of Great Bay Refuge, and any other refuge issues they wanted to raise. Eleven copies of the workbooks were completed and returned, along with other written responses.

We held a meeting with 26 representatives of State and Federal partners on July 8, 2009, at the Great Bay Discovery Center in Stratham, New Hampshire. The purpose of the meeting was to identify issues, determine the significant resource values attributed to the refuge, and to seek advice from technical experts on what resources of conservation concern in the refuge planning area should be a management priority.

We compiled a list of key issues, concerns, and opportunities to address in the CCP based on comments at the public meeting, the written responses and completed workbooks we received, our meeting with State, local, and other Federal agencies, and from internal discussions with refuge, planning, and other Service programs. These issues are described in more detail below under the heading, “Issues, Concerns, and Opportunities.”

#### **Steps C and D: Vision, Goals, and Alternatives Development**

We developed a draft vision statement and goals after consideration of the refuge’s purposes, the Refuge System mission and goals, the results of scoping and the issues and opportunities identified (see below), and after an evaluation of the role the refuge could play in supporting landscape-level conservation plans developed by either the Service or our partners. We continued to consult with experts throughout 2009 and 2010, and to meet regularly as a core team, as we refined the refuge vision and goals, and developed and evaluated our proposed management alternatives.

#### **Step E: Draft CCP and NEPA document**

Between July 2009 and January 2012, the core team worked on drafting the CCP/EA. We published a notice of availability in the *Federal Register* announcing our release of this draft for a 39-day period of public review and comment on February 10, 2012. During that comment period, we held two public meetings to obtain comments directly from individuals. We also received comments by regular mail and e-mail. After the comment period ended, we reviewed and summarized all of the comments received, developed our responses, and revised the CCP as warranted based on the comments. We include a summary of these comments, and our responses to them, as appendix K in this document.

#### **Step F: Adopt Final Plan**

We submitted the final plan to our Regional Director for review in June 2012. The Regional Director selected alternative B from the draft CCP/EA, along with several minor changes, to implement in the final plan. Our Regional Director also determined that a FONSI was appropriate (see appendix L), and certified this

final CCP meets agency compliance requirements, achieves refuge purposes, and helps fulfill the mission of the Refuge System. With an affirmative FONSI and other positive findings, the Regional Director approved the final CCP. We will publish another notice of availability in the *Federal Register* to announce the final decision and availability of the final plan. We will also distribute a newsletter announcing this decision to all contacts on our project list as well as post that newsletter on our Web site. These actions will complete planning step F to prepare and adopt a final plan.

#### **Step G: Implement, Monitor, and Evaluate Plan and Step H: Review and Revise Plan**

We will begin to implement the plan and monitor our success immediately after we publish our final notice of availability in the *Federal Register*. Over the 15-year life of the plan, we will annually review the plan to see if it requires any revisions. We will update and revise the plan at least every 15 years, or sooner if significant new information becomes available, ecological conditions change, a major refuge expansion occurs, or we identify the need to do so during our annual reviews.

### **Issues, Concerns, and Opportunities**

We developed a list of key issues to address in the CCP from the responses to our issues workbook, public scoping meeting, technical meeting with partners, and planning team discussions. We define issues and concerns as “any unsettled matter requiring a management decision.” This can be an “initiative, opportunity, resource management problem, threat to a resource, conflict in use, or a public concern.” The following summary provides a context for the issues that arose during the scoping process.

### **Habitat and Species Management**

The refuge was acquired in 1992, to conserve fish and wildlife and their habitats and to protect water quality. This is the foundation for what we do on the refuge. Despite its relatively small size at just over 1,100 acres, Great Bay Refuge is surprisingly diverse in its habitats and the species that it supports. The wide variety of habitats on the refuge is the result of human disturbances and past land uses. The grasslands and impounded wetlands are examples of habitats that were created prior to Service ownership, and are now maintained to benefit wildlife. The refuge’s shoreline along Great Bay Estuary is important in protecting water quality in the bay. The refuge’s salt marsh and rocky shoreline, as well as adjacent intertidal areas, are critical to the health of the entire Great Bay Estuary.

We heard a range of opinions, particularly from our partners, on which habitat types we should emphasize and which Federal trust and State species of concern should be a management focus. Some of those habitats favored, in particular those for grassland and shrublands habitats, can be labor-intensive and expensive to maintain. Impounded wetlands can also require intensive management and maintenance. All habitat management decisions present tradeoffs between various suites of species that use different habitat types. Many people noted the potential role of the refuge in helping to restore oysters and eelgrass in the bay. The history of the refuge as a former Air Force Base presents some species and habitat management considerations due to remaining military infrastructure and historic buildings and environmental contaminants.

The following key issues and concerns arose concerning habitat and species management:

- What is the appropriate contribution of the refuge to regional landscape habitat goals, including grassland and shrubland habitats?

- Which grassland and shrub habitat areas on the refuge should be maintained? How will we manage for them on the refuge?
- Which upland forest habitats and forest-dependent species should be management priorities? How will we manage for them on the refuge?
- How should we manage the former Weapons Storage Area, consistent with refuge goals and objectives?
- What role, if any, should the refuge have in restoring New England cottontail, a candidate for the Federal list of threatened and endangered species?
- What is the refuge's role in restoring Karner blue butterflies to the Concord Pine Barrens?
- How will we balance the management of aquatic habitats for wetland-dependent birds, fisheries, and biological integrity?
- How will we manage the refuge's impoundments? Should we pursue restoration of wetland habitats through dam removal?
- How will we ensure the integrity of water quality to protect freshwater and saltwater-dependent species?
- What role should the refuge have in helping to restore oysters and eelgrass beds in Great Bay Estuary?
- How will the refuge manage exemplary natural communities and protect rare plant populations?

## **Invasive Species**

Invasive species are those that are nonnative (or alien) to the area and which cause, or are likely to cause, economic or environmental damage or harm to human health. Great Bay Refuge began a systematic inventory and mapping of invasive plant species in 2002. Much of the refuge has been mapped and 34 invasive species recorded. This is typical of southeastern New Hampshire, and especially on lands previously disturbed, like the refuge. Invasive plant species are a significant management challenge given that they occur in all habitats on the refuge. Invasive species control methods used on the refuge include hand pulling with weed wrenches, annual mowing, herbicides, and biological controls for purple loosestrife. In addition to invasive plants, the nonnative mute swan occurs in Great Bay waters, including the refuge. The Service has partnered with NHFG to control this species given its negative impact on native waterfowl and their habitats.

The following key issues and concerns arose concerning invasive species:

- Which invasive species should be a priority for control on refuge lands?
- How will we control specific invasive plant and animal species on refuge lands?

## **Environmental Contaminants**

As the site of a former Pease Air Force Base, the refuge still has potential contaminant issues. The adjacent Pease Airport presents additional challenges because runoff from the airport could flow onto the refuge. The airport authority is currently installing new de-icing pads not far from the refuge boundary. It is unclear what, if any, potential threat runoff from these pads might pose to refuge resources.



The following key issues and concerns arose concerning environmental contaminants:

- How will we address environmental contaminants resulting from past land uses and from offsite activities?
- How will we work with the Pease Airport Authority to protect water quality and address potential airport/wildlife conflicts?

### **Landscape-scale Conservation and Climate Change**

Historically, wildlife conservation efforts have tended to focus on single species or small suites of species. Given the changing landscape and climate, we need to manage and collaborate with partners beyond traditional boundaries. Some impacts—such as climate change, urbanization, resource extraction, and other economic and social pressures—occur at scales well beyond the boundaries of a single refuge and affect entire ecosystems, not just a few species. Landscape-level conservation involving multiple partners working together across large regions might be one of the most effective and important ways to help species of conservation concern and their habitats. Research collaboratives among multiple partners and at multiple scales can identify regional trends that would inform site specific management on the refuge. Almost all the respondents to the issues workbook supported a greater refuge role in protecting habitats outside the current refuge boundary. This included support for all methods of habitat conservation, including fee simple and conservation easement acquisition, supporting other conservation partners in their acquisitions, landowner education, and habitat restoration on private lands.

The following key issues and concerns arose concerning landscape-scale conservation and climate change:

- What role should the Service play in conserving lands and habitats in the Great Bay watershed and in the Concord Pine Barrens?
- How can the refuge work with partners to improve the water quality of the Great Bay Estuary?
- How can the refuge enhance its partnerships within the region to meet landscape-scale conservation concerns, such as climate change, invasive species, land development, and habitat fragmentation?
- What actions can the refuge take, in partnership with others, to minimize impacts from climate change?
- What role should the refuge play in regional research collaboratives that address management issues of concern to the Service?

### **Public Uses and Community Partnerships**

The Refuge Improvement Act identified wildlife observation and photography as priority public uses for refuges, along with environmental education, interpretation, hunting, and fishing. In 2006, a regional visitor services team identified wildlife observation and photography as the areas of emphasis for Great Bay Refuge. We heard during public scoping that the primary reasons that many people visit the refuge are for wildlife and nature viewing, specifically for bird watching and hiking the nature trails. Many respondents also wanted to see more access and more trails on the refuge, but supported the primary roles of the refuge as conserving habitat and protecting water quality. Our partners recognize that not all priority public uses can be provided on the refuge, and that some of these activities are available on other lands in the Great Bay area that are open to the public.

The lack of staffing at the refuge has limited our ability to expand and monitor public uses on the refuge, and outreach to the community to offer environmental education and interpretive programs in collaboration with our community partners. Partnerships, including the existing core volunteer group, are essential to meeting the vision and goals of Great Bay Refuge. In 2008, volunteers contributed 2,500 to 3,000 hours to the refuge.

The following key issues and concerns arose concerning public uses and community relations:

- What are the appropriate types and levels of wildlife-dependent public uses on the refuge?
- How will we manage compatible, nonpriority public uses on the refuge?
- What staffing levels are needed to enhance onsite interpretation, environmental education, and outreach programs to reach a wider audience?
- What partnership opportunities exist to increase the number of environmental education, interpretation, and outreach programs?
- How will the refuge cultivate an informed and educated public to support the mission of the Service and the purposes for which the refuge was established?
- How will we build and maintain an active volunteer program?

## **Cultural Resources**

At least 22 archaeological or historical sites are present on Great Bay Refuge, including the remains of brick factories, ferry landings, and the foundations of buildings that were once part of local dairy operations. Two structures from the former Margeson Estate, the main house and a caretakers's residence, remain on the refuge and are located on Long Point Road in an area closed to the public. Both structures are listed as part of a district nomination in the National Registry of Historic Places. As a Federal land management agency, we are responsible for locating and protecting cultural resources, including archaeological sites and historic structures. Balancing the protection of historic resources with the refuge's primary purposes of wildlife and habitat conservation is a management challenge.

The following key issues and concerns arose concerning cultural resources:

- How should we steward the historical structures on the refuge, including the Margeson Estate?
- What should we do with other remaining structures, including the bunkers and other infrastructure remaining from the former Air Force base?
- How will we preserve, protect, and interpret cultural resources on refuge lands?

## Chapter 3

Steve Hillebrand/USFWS



*Great blue heron*

# Existing Environment

- Introduction
- Water Quality and Health of the Great Bay Estuary
- Conserved Lands Network
- Land Use Trends
- Climate
- Part I. The Regional Setting
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  - Karner Blue Butterfly Conservation Easement

## Introduction

This chapter describes the ecological, physical, and socioeconomic setting of Great Bay Refuge in a regional and local context. We first describe the regional landscape, including its historical and contemporary influences. We then describe the refuge and its resources.

## Part I. The Regional Setting

In addition to the 1,103-acre Great Bay Refuge, we also administer the 29-acre conservation easement in Concord, New Hampshire, and manage it as pine barrens habitat for the federally endangered Karner blue butterfly. The conservation easement is approximately 45 miles west of Great Bay and is described separately below.

Great Bay Refuge lies within the Gulf of Maine watershed, an immense area extending from eastern Quebec, Canada, to Cape Cod in Massachusetts. Along New Hampshire's coast, the Gulf of Maine's tidal waters flow twice daily up the Piscataqua River through Little Bay and then into Great Bay at Furber Strait. Collectively, these water bodies are described as the Great Bay Estuary system. This is one of the most productive ecosystems on the East Coast (Odell et al. 2006). The refuge sits on the eastern shore of Great Bay.

The Great Bay Estuary is approximately 10 miles inland from New Hampshire's seacoast and adds more than 130 miles of tidal shoreline to the 18 miles of shoreline along the State's coast. Seven major rivers flow into the Great Bay Estuary system: the Winnicut, Squamscot, Lamprey, Oyster, Bellamy, Cocheco, and Salmon Falls. Together these rivers drain nearly 1,000 square miles. The major habitats in Great Bay are eelgrass meadows, mudflats, salt marsh, channel bottoms, and rocky intertidal habitat. These habitats support over 160 bird, fish, and plant species, 26 of which are State-listed threatened or endangered (see appendix A) (<http://greatbay.org/about/index.htm>; accessed May 2011). Birders from all over the world come to view migratory birds on Great Bay (NHEP 2000). Great Bay Estuary also provides numerous fishing and shellfishing opportunities, such as recreational oyster and clam harvesting; recreational fishing for striped bass, bluefish, alewife, and blueback herring; commercial and recreational lobstering; and commercial trapping of American eels for bait and for export.

Great Bay Refuge is located on a portion of the former Pease Air Force Base. The rest of the former base is now Pease International Tradeport (Tradeport). The approximately 3,000-acre Tradeport has office and industrial spaces, an active airport, restaurants, hotels, and other amenities. Past land uses, including farming and 30 years of use as an Air Force Base, dramatically changed the upland plant community from an Appalachian oak-pine forest to a mix of transitional pine-hardwood forest, shrubs, fields, and impounded waters. Only some remnants of the historical forest community remain in the area.

*Storage bunker in former  
Weapons Storage Area*



## Water Quality and Health of the Great Bay Estuary

Several centers of ecological research and management in the area provide a detailed picture of the historical and current health of the Great Bay Estuary and watershed. These centers, described in more detail in chapter 1, include PREP, GBNERR, and NHCP, among others.

In an overview on the restoration of the Great Bay Estuary, Odell et al. (2006) summarized the condition of the estuary system as follows:

“A close look at the history and current condition of the Great Bay estuarine system reveals that although it is relatively intact and remarkably resilient, it has been significantly altered and degraded. Prior to 1900, all of the rivers and many of the tributaries were dammed, extensive logging throughout the watershed brought tons of silt into tidal rivers, the bay bottom was covered in sawdust up to a foot deep and poisoned with industrial wastes, and aquatic resources were over harvested. Since that time, significant human population growth and development throughout the Great Bay watershed have created new stresses—notably habitat loss, and new levels and types of point and non-point source pollution.”

A concerted effort to understand, protect, and restore the Great Bay Estuary is underway among many local, State, and Federal partners. Particular emphasis is placed on land protection, controlling discharges from wastewater treatment plants and other pollution sources, and using best management practices to minimize impacts from development and resource extraction (Odell et al. 2006).

Every 3 years, PREP compiles a report on the “State of the Estuaries.” The report tracks trends in 12 environmental indicators to assess the health of New Hampshire’s estuaries. The report describes each indicator as having an either positive, negative, or cautionary trend. A cautionary trend is a trend that demonstrates possibly deteriorating conditions, but more information is needed to fully assess the indicator. In the 2009 report, 11 out of the 12 indicators showed either negative or cautionary trends for Great Bay (table 3.1). In the previous 2006 report, only 7 out of the 12 indicators had either negative or cautionary trends. The report recognizes that although there have been many successful projects to conserve land or restore habitat around Great Bay, these projects have not been able to keep up with continued habitat loss and human development (PREP 2009).

**Table 3.1. Environmental Indicator Trends in the Great Bay Estuary (PREP 2009).**

Indicator	Situation	Trend*
Dry weather bacteria concentrations	Concentrations in Great Bay decreased significantly in the 1990s, but no change in last 10 years.	!
Toxic contaminants in shellfish	Concentrations of a petroleum product have increased by 218 percent in the Piscataqua River over past 16 years.	!
Toxic contaminants in sediments	Toxic contaminants found in 24 percent of estuarine sediment.	!
Nitrogen in Great Bay	Dissolved inorganic nitrogen concentrations increased in Great Bay by 44 percent in past 25 years; the total nitrogen load to Great Bay increased 42 percent in past 5 years.	—
Dissolved oxygen	Levels fall below State standards often in tidal rivers, rarely in the bay.	!
Oysters	Number of adult oysters in Great Bay declined by 95 percent in the 1990s; the population has increased slowly since 2000.	—



Indicator	Situation	Trend*
Eelgrass	Eelgrass cover in Great Bay has declined by 37 percent between 1990 and 2008 and completely disappeared from the tidal rivers, Little Bay, and the Piscataqua River.	–
Anadromous fish	Returning anadromous fish are limited by various factors including water quality, passage around dams, and flooding.	!
Habitat restoration	Yes for salt marsh, but oyster and eelgrass habitats have been restored at a slower rate.	!
Impervious surfaces	In 2005, 7.5 percent of the land area of the watershed was covered by impervious surfaces, and 9 subwatersheds had greater than 10 percent impervious cover. In 2005, the town of Newington, NH had 20.2 percent imperviousness; up from 13.2 percent in 1990.	–
Land conservation	At the end of 2008, 76,269 acres in the Piscataqua watershed are protected, which amounted to 11.3 percent of the land area.	+

\* + is a positive trend; - is a negative trend; ! is a cautionary trend.

## Conserved Lands Network

Great Bay Refuge is within the boundaries of GBNERR (map 3.1). The reserve was designated in 1989, encompassing 4,500 acres of tidal waters and wetlands and 3,000 acres of surrounding upland. The refuge and the reserve are part of the Great Bay Resource Protection Partnership (GBRPP), a coalition working to permanently protect land in 24 towns around Great Bay, including those within the boundaries of the reserve (map 1.1). The partnership funded the protection of 5,098 acres in the Great Bay region from 1996 to 2008, and an additional 3,052 acres were protected as a match to the partnership-funded lands (<http://www.greatbaypartnership.org/index.html>; accessed May 2011).

Great Bay Refuge is the largest block of protected land on Great Bay. Table 3.2 lists other key conserved lands around the Great Bay Estuary.

**Table 3.2. Conservation Lands Bordering Great Bay Estuary**

Name	Town	Acres	Ownership
Great Bay National Wildlife Refuge	Newington	1,103	U.S. Fish and Wildlife Service
Fox Point	Newington	119	Town of Newington
Wagon Hill Farm	Durham	130	Town of Durham
Adams Point	Durham	70	NH Fish and Game
Wilcox Point	Durham	38	NH Fish and Game
Lubberland Creek	Newmarket	70	The Nature Conservancy
Shackford Point	Newmarket	34	NH Fish and Game
Sandy Point (Great Bay Discovery Center)	Greenland	46	NH Fish and Game
Great Bay Wildlife Management Area	Greenland	32	NH Fish and Game

## Land Use Trends

Despite the network of conservation lands in the Great Bay watershed, future growth is a concern, especially in the northern portion of the watershed on those lands not protected. As the population of the region increases, there is an associated increase in sources of pollution. Developed lands also reduce or fragment wildlife habitat. Development creates more impervious surfaces, such as paved roads, parking lots, and buildings. Impervious surfaces increase the volume

Map 3.1. Resource Protection Areas



Osprey



and velocity of stormwater runoff and the sediment and pollutant load flowing into the estuary. Because of this, the amount of impervious surface in a watershed is a good indicator of stream and water quality (PREP 2009). Generally, water quality deterioration is expected in watersheds with greater than 10 percent impervious surface. According to PREP, 7.5 percent of the land area of the Piscataqua watershed was covered with impervious surface in 2005. Impervious surfaces continue to be added to the watershed at a rate of approximately 1,500 acres a year (PREP 2009). The town of Newington, where the refuge is located, has one of the highest levels of impervious surfaces in the watershed; increasing from 18 percent in 2000 to over 20 percent in 2005 (PREP 2009).

## Climate

Along the coastal lowlands, winter temperatures average about 30°F and summer temperatures average about 80°F. At higher elevations and further inland, winter temperatures are often 10 to 12°F cooler. Afternoon sea breezes affect the refuge in spring and summer, with noticeable wind shifts at about 11 a.m. and again just before sunset. Further inland, low elevation areas can be 5 to 10°F warmer during summer, but cooler as elevation rises. Annual precipitation is uniform throughout the year with the wettest month being November (greater than 5 inches on average). Total annual precipitation Statewide is about 45 inches. Annual snowfall for coastal areas is 50 inches and higher, inland elevations can receive 150 inches. Much of the precipitation is the result of cooler air from the polar region meeting a warmer, moist southerly air mass riding the Atlantic seaboard northward (Schroeder 1970). The resulting storms can be quite severe and can occur year-round.

## Air Quality

The Clean Air Act of 1963 (P.L. 88-206), as amended, requires EPA to set National Ambient Air Quality Standards for pollutants considered harmful to public health and the environment. The Clean Air Act established two types of national air quality standards: primary and secondary standards. Primary standards set limits to protect public health, including the health of sensitive populations such as people with asthma, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, and damage to animals, crops, vegetation, and buildings (<http://www.airmap.sr.unh.edu/background/naaqs2.html>; accessed May 2011).

The EPA has also developed an Air Quality Index (AQI) that incorporates their standards for carbon monoxide, nitrogen dioxide, ozone, particulates, and sulfur dioxide. The AQI is used to measure the severity of air quality impacts to human health. Table 3.3 provides a summary of AQI values for in Rockingham County, New Hampshire, from 2001 to 2011. Below we provide more detailed information on regional air quality issues and sources of air pollution.

**Table 3.3. Air Quality Index Values for Rockingham County, New Hampshire, 2001 to 2011.**

Years	Number of Days when Air Quality was...				
	Good	Moderate	Unsafe for Sensitive Groups	Unhealthy	Very Unhealthy
2001	311	36	16	2	-
2002	267	70	25	3	-
2003	394	62	9	-	-
2004	311	50	4	1	-
2005	309	50	6	-	-
2006	310	47	8	-	-
2007	323	33	8	1	-
2008	331	31	4	-	-
2009	342	21	2	-	-
2010	328	34	3	-	-
2011	314	49	2	-	-
2011	314	49	2	-	-

Source: EPA 2012 ([http://www.epa.gov/airdata/ad\\_rep\\_aqi.html](http://www.epa.gov/airdata/ad_rep_aqi.html); accessed May 2012).

### **Regional Air Quality Issues and Sources of Air Pollution**

Between 2001 and 2011, the main air pollutants in Rockingham County, New Hampshire were ozone, nitrogen dioxide, sulfur dioxide, and particulate matter. Of these four pollutants, regional ozone levels most frequently exceed EPA standards. Ozone at ground-level is a pollutant that forms in the atmosphere as a by-product caused by the release of volatile organic compounds and nitrogen oxides emitted from automobiles, diesel trucks, and industrial sources. It can lead to a variety of human health concerns, including chest pain, coughing, throat irritation, and can reduce lung function. It can also worsen asthma, emphysema, and bronchitis (EPA 2009). During the summer, most of southern New Hampshire and coastal Maine experiences ozone events that are considered very unhealthy for humans and the environment. These very high ozone levels are caused by a combination of factors (e.g., dense population, local pollution sources, and being downwind of sources outside the region). On average, southern New Hampshire and coastal Maine experience 3 to 5 days per year of very unhealthy ozone levels, with some years (e.g., 1988) that are much worse. The Dover-Portsmouth-Rochester, New Hampshire region is also designated as “serious non-attainment zones” because the region often exceeds the air quality standards for ozone set by the EPA.

The sources of these pollutants and other air quality issues in the region are largely the result of the influx of airborne pollutants originating from industrial regions, metropolitan centers, and transportation corridors located upwind, and primarily from the Midwest and Mid-Atlantic regions. Many unknowns still exist about air quality in New England, including the specific sources of pollution, and effects of weather patterns and climate changes (Wake et al. 2004). However, industrial and transportation sources within New England also contribute to air quality issues (Wake et al. 2004). The New Hampshire seacoast, including the town of Newington, is heavily commercialized and local sources of air quality issues include industrial, commercial, and transportation sources such as the National Gypsum plant, which manufactures gypsum wall boards, in Portsmouth, New Hampshire, the Public Service of New Hampshire (PSNH) Schiller Station, which operates three coal and wood-burning steam boilers, in Newington, New Hampshire, and emissions from heavy automobile traffic.



## The Historical Picture

### After the Ice Age

New England emerged from an ice age 12,000 years ago. A 1-mile thick glacier scraped and molded the valleys, slopes, and mountain tops, leaving behind a landscape bare of vegetation. At the southern edge of the glacier, however, plants survived and immediately began to recolonize the newly exposed soils (Marchand 1987). Large mammals, including mastodons, wandered the spruce parkland and grassy savanna, but disappeared quickly at the same time the glacier receded and humans advanced across the region.

Continual weathering and erosion of rock over time released nutrients and created new soils for plants to grow. Hardwood and softwood tree species advanced independently of one another creating different forest communities through time (Davis 1983). The sequence of plant species' arrivals as the glacier receded was also different at different sites (Davis 1981). In a relatively short time period (about 2,000 years), the land cover changed from tundra to woodland with scattered trees, and then to closed canopy forest. Pine and oak arrived around 11,500 years ago with a warmer and drier climate. Eastern hemlock became more prevalent around 10,000 years ago with a wetter climate (Manomet Center 2010). Graham (1992) reported similar species-specific responses by mammals to post-glacier climate changes.

### Native People

Prior to European arrival, coastal southern New England likely supported a “shifting mosaic” of open land habitat within a mostly forested landscape. The open lands were a result of native heathlands, grasslands and shrublands, extensive beaver meadows, periodic fires, shifting agriculture by Native Americans, and occasional hurricanes (Cronin 1983, DeGraaf and Yamasaki 2001). DeGraaf and Yamasaki (2001) and Askins (2000) reported broad evidence for the presence of extensive grasslands along the coast and major rivers in pre-European New England, although not all of these open areas are attributed to Native American influences.

Native Americans in southern New England fished and shellfished for much of their food, as well as hunting birds and trapping and hunting small game. When colonists landed on Massachusetts shores in the early 1600s, they saw large clearings and open woodlands. Waterfowl, deer, ruffed grouse, wild turkey, and wild pigeons were abundant (Marchand 1987, Foss 1992, DeGraaf and Yamasaki 2001). Colonists found old growth forests not far inland, including old stands of mixed hardwoods, white pine, and hemlock at low elevations, and spruce and fir in the mountains (Marchand 1987).

### European Settlement

European contact (e.g., explorers and traders) with native people began during the 16th century in New England. Foster and Motzkin (2003) suggested that European arrival prompted such rapid and profound changes to the lifestyle and land use practices of indigenous people that by the time colonists began to settle here, the landscape was already altered. Foster and Motzkin (2003) suggested that expansive clearing for agriculture and semi-permanent (rather than mobile) villages were a new phenomenon and resulted from European influence.

European colonists brought new land use concepts such as permanent settlements and political boundaries. They shifted land use from primarily subsistence farming and gathering to harvesting and export of natural resources (Foss 1992). Just 100 years after the colonists arrived, the forests were rapidly being logged. By 1830, central New England was 80 percent cleared (Marchand 1987).

However, shortly after this, many people began leaving the rough, rocky New England landscape for other opportunities. The abandonment was due to a variety of factors, including the California Gold Rush, the Industrial Revolution, new railroads, richer Midwestern soils, and the Civil War. Abandoned farm fields began reverting back to forest. White pine seeded into the fields and pastures



and by 1900 was ready for harvest. An understory of hardwoods, released from the shade of white pine, emerged as the new dominant vegetation. This is a legacy that remains today (Marchand 1987, DeGraaf and Yamasaki 2001).

The Great Bay Estuary was long a center of commerce for natural resource based industries including fishing and logging. Early settlers exploited the region's extensive forests and abundant populations of salmon, shad, sturgeon, alewife, blueback herring, and shellfish. Flat-bottomed gundalows, a type of sailing barge, were used to transport cargo up and down the swift-current and shallow waters of the Piscataqua River to and from the towns on Little Bay and Great Bay. Shoe and textile mills were built on the water's edge of the towns within the estuary (Jones 2000). By 1790, Portsmouth, New Hampshire was the 14th largest city in the country, known for its shipping and fishing industries (Bolster 2002). Growing human populations, accompanied by unchecked sewage disposal and dumping of industrial wastes degraded the water quality in the estuary, led to population declines of fish and shellfish. Beginning in the 1940s, pollution controls began to improve water quality and habitats in Great Bay (Jones 2000).

### **Climatic Effects and Natural and Human Disturbances**

The Northeastern U.S. is particularly cold, given its latitude (Marchand 1987). The reason for the region's cold climate is partly a result of the pattern of atmospheric circulation in this hemisphere. Low pressure systems all converge on New England, regardless of their origin, and pull cold Canadian air in behind as they pass over the Northeast (Marchand, 1987). New England weather conditions are influenced more by the North American landmass than by the Atlantic Ocean except along the coastline (Taylor et al. 1996). Forty to forty-five inches of precipitation fall about evenly throughout the year, although drought periods occur in some years (Patterson and Sassaman 1988).

Natural disturbances vary across New England, depending on geographic location, forest type, and local conditions. In presettlement times, coastal regions experienced the highest rates of disturbance because of the prevalence of fire-dependent sandy pine-oak barrens, higher densities of Native Americans, higher frequencies of hurricanes, and longer snow-free periods. These disturbance regimes may have maintained about 1 to 3 percent of the inland northern hardwoods forests and greater than 10 percent of the coastal pine-oak barrens, in early successional habitat (Lorimer and White 2003).

Native insects and disease, ice storms, droughts, and floods have caused both minor and major disturbances. Lorimer and White (2003) depicted hurricane frequencies as varying from 85 years in southeastern New England, 150 years through central Massachusetts and the southeast corner of New Hampshire, to 380 years or more in northern New England. Lorimer (1977) estimated catastrophic disturbances from fire and wind at intervals of 800 and 1,150 years, respectively.

Agriculture, logging, fire, wind, exotic pests and diseases, and development have significantly altered the New England landscape. Agriculture had the greatest effect on New England's forests, causing major changes in cover types and soils over a vast area. Although most of the region's forests were cut at least once, most logging did not affect succession or impact soils (DeGraaf and Yamasaki 2001). Human settlements are emerging as the major cause of permanent habitat loss compared to previous impacts from agriculture and logging.

### **Climate Change**

Climate changes are predicted to affect climate patterns over time (Lorimer 2001). The greatest effects of climate change will be on regional air and water temperatures, precipitation patterns, storm intensity, and sea levels. In the Northeastern United States, the average air temperature is expected to rise by

8°F by 2100, with the greatest increase during winter months (Frumhoff et al. 2007). New Hampshire's summers are anticipated to be similar to those currently experienced in Virginia (Frumhoff et al. 2007). Climate change is anticipated to influence natural disturbances patterns and result in a decrease in freeze periods, decreased snow cover, increased storm intensities and frequencies, increased intensity and frequency of summer droughts, damaging ozone, and an increase in the spread of invasive species and disease (NHFG 2005, Manomet Center 2010). The resulting effects on wildlife and habitats are expected to be variable and species-specific, with a predicted general trend of ranges shifting northward by 350 to 500 miles (Frumhoff et al. 2007).

Tidal marshes are among the most susceptible ecosystems to climate change, especially rapid sea level rise. In an effort to address these potential effects on national wildlife refuges, the Service ran Sea Levels Affecting Marshes Model (SLAMM) 5.0 analyses to estimate the impacts of sea level rise for all coastal refuges, including Great Bay Refuge. The model predicted that the salt marshes at Great Bay Refuge would be resilient to the effects of sea level rise, with very little conversion of uplands to wetland habitat (Clough and Larson 2009). The majority of the refuge is dominated by oak-hickory forest, which is at the northern edge of its range. Under climate change scenarios, this forest type is expected to persist and expand northwards. Increasing summer droughts and disease is expected to increase the likelihood of forest fires, which the oak-hickory habitat is adapted to. Two habitats on the refuge that are vulnerable to climate change are hemlock communities and forested wetlands. The hemlock woolly adelgid, an invasive pest, is currently at the northern edge of its range in southern New Hampshire, and is expected to expand northwards with increasing winter temperatures. Earlier flooding and prolonged summer drought may result in a reduction of forested wetlands on the refuge and decrease both the quantity and quality of these habitats for wetland-dependent species, such as northern leopard frog and willow flycatcher. The main guiding principal of the Service's climate change adaptation planning is to maintain or increase resiliency of the refuge's habitats and ecological process. The uncertainty about the future effects of climate change also requires refuge managers to use adaptive management to maintain healthy ecosystems in light of the unpredictability (Inkley et al. 2004).

*Opossum*



Tim Williams.

### Wildlife Changes

Wildlife populations ebb and flow as habitat conditions vary in space and time. Natural and human disturbances intervene, shifting species abundance and diversity. Some species, such as alpine plants, have been here for 10,000 years or more. Others, like the coyote, arrived in the last 75 years. Change is inevitable and natural, although human activities in the last 400 years have significantly altered the landscape compared to the previous 10,000 years when humans first colonized the northeast (Foss 1992).

During the 1800s, many wildlife species declined because of habitat loss (e.g., forest clearing), bounty and market hunting, millinery trade (for feathers to use in hats), and natural history specimen collecting (Foster et al. 2002). The millinery trade in the late 1800s, and hunting and egg collecting (for food and bait) decimated Arctic, common, and roseate tern populations in the Gulf of Maine (Drury 1973). Mountain lion, gray wolf, elk, and caribou were extirpated from the area by the mid-1800s or early 1900s and have not recolonized the region. Heath hen, passenger pigeon, great auk, Labrador duck, and sea mink became extinct at the hand of humans during the same period (DeGraaf and Yamasaki 2001, Foster et al. 2002).

The historical record is unclear on the abundance and distribution of open land plant and animal species in the Northeast prior to European settlement (Foster and Motzkin 2003). Scattered large grasslands occurred in coastal areas including the approximately 59,300-acre Hempstead Plain on Long Island and the blueberry barrens along the Maine coast (Askins 1997, Winne 1997). Smaller, more temporary grasslands were created when beavers abandoned their dams, or by fires set by lightning or humans (Askins 1997). Some grassland bird species, such as horned lark and dickcissel, likely spread eastward from the Midwest as lands here were cleared for agriculture. However, some grassland birds, including bobolink, eastern meadowlark, and upland sandpiper, may have existed here long before European settlement in these coastal barrens, heathlands, and grasslands (Askins 1997). Populations of grassland birds have declined significantly across their range in the last 40 years (Askins 1997, Norment 2002). After farm abandonment escalated in the early 1900s, wildlife species that prefer thickets, brush lands, and young forests increased (Litvaitis 2003).

The young hardwood forests that emerged in the 1920s and 1930s provided premier habitat for ruffed grouse (DeGraaf and Yamasaki 2001). The succession of that forest into mature hardwood forests in the late 1900s caused a decline in the grouse population but an increase in other species that prefer more mature forests. Abundances of early successional species declined to levels approaching presettlement levels (Litvaitis 2003).

Eastern coyotes were first sighted in New Hampshire and Vermont in the 1940s, in northern Maine in the 1930s, and in Massachusetts in the 1950s. DeGraaf and Yamasaki (2001) reported three major trends in New England's wildlife: forest species are increasing (e.g., American black bear, beaver, deer, wild turkey, pileated woodpecker), grassland and shrubland species are declining (e.g., grasshopper sparrow, bobolink, upland sandpiper, whip-poor-will), and many southern species are expanding their ranges northward (e.g., glossy ibis, willet, Carolina wren, northern cardinal, northern mockingbird, Virginia opossum). A few species, such as common raven, fisher, and moose are expanding southward. A group of species remains regionally extirpated, including wolverine and mountain lion, although Canada lynx have returned to northern Maine and New Hampshire (DeGraaf and Yamasaki 2001).

## **Regional Demographics and Economic Setting**

### **Population and Demographics**

Great Bay Refuge is located in southern New Hampshire in the town of Newington in Rockingham County. Its close proximity to metropolitan areas, including Boston, Massachusetts, and Manchester, New Hampshire, expose the refuge to the effects of urban sprawl. As real estate in cities and their outskirts becomes scarce and more expensive, city residents look outward for more affordable housing. In addition, New Hampshire offers numerous scenic and natural areas, and opportunities for outdoor recreation.

An analysis of population data by the New Hampshire Office of Energy and Planning (NHOEP) shows the State divided into the slow-growing north and the fast-growing south. Since 1960, New Hampshire's population has increased by about 703,000 people. More than 60 percent of that growth occurred in Rockingham and Hillsborough Counties. This growth is expected to shift away from Rockingham County because of the decreasing availability and increasing cost of land, and the greater freedom to reside in and commute from more remote

communities. In contrast, Merrimack County is expected to gain in the State's future share of growth (NHOEP 2006).

Rockingham County's 695 square miles of land area contained 426 persons per square mile in 2007. The estimated 2007 population of Rockingham County is 296,543, an increase of 19,184 people since 2000. Rockingham County was the second most populated county in the State in 2007, accounting for about 23 percent of New Hampshire's total population. From 2005 to 2007, the median age in Rockingham County was 40.2 years. Persons under 18 years accounted for 24 percent of the population, while 11 percent were 65 years or older (USDOC 2007). Table 3.4 presents the population trends for Rockingham County and the communities surrounding the refuge.

**Table 3.4. Population Trends for Communities and the County Around Great Bay Refuge.**

	Population in 2010			Percent Population Change	Projected Population
	Residents	Persons per Square Mile	Median Age	2000-2010	2020
<b>New Hampshire</b>	1,316,170	147.0	41.1	+6.5	1,470,010
<b>Rockingham County, NH</b>	295,223	424.8	42.3	+6.4	331,190
<b>Newington, NH</b>	753	94.1	48.0	-2.8	900
<b>Greenland, NH</b>	3,349	334.9	43.8	+4.4	3,880
<b>Portsmouth, NH</b>	20,779	1,298.7	40.3	-0.02	22,730

*Source: U.S. Census Bureau (2010) and New Hampshire Office of Energy and Planning (projections compiled Jan 2007 based on past trends).*

## Environmental Justice

Executive Order #12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations," (dated February 11, 1994) requires Federal agencies to identify and address any potential disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The Presidential Memorandum accompanying this order further directs Federal agencies to improve opportunities for community input and the accessibility of meetings, documents, and notices (CEQ 1997). To facilitate this, Federal agencies should also consider if a significant portion of the affected community is linguistically isolated, and as warranted, provide translated documents and other appropriate outreach materials.

In creating table 3.5 below, we used the following definitions:

- **Minority population** includes persons who are members of the following groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.
- **Low-income population** includes persons living below the poverty line.
- **Linguistically isolated population** includes persons who speak English less than "very well."



**Table 3.5. Regional Environmental Justice Characteristics.**

	Rockingham County, NH	Town of Newington, NH
<b>Minority Population</b> (as percent of total population)	6.2 percent	5.8 percent
<b>Low-income Population</b> (as percent of total population)	5.0 percent	6.8 percent
<b>Linguistically Isolated Population</b> (as percent of total population)	1.8 percent	3.4 percent

Source: U.S. Census Bureau (2010).

## Business and Economic Climate

New Hampshire has made several economic transitions in the past. Historically, the area was agriculturally based. The economy later shifted to textile and leather goods manufacturing during the Industrial Era and then shifted again to the manufacturing of higher valued goods such as fabricated metal and electrical goods. Currently, the State is in transition to a post-manufacturing, service-based economy (NHOEP 2006).

New Hampshire has a 70 percent “labor force participation rate.” This means that 70 percent of the population age 16 and older is either employed or unemployed but able to work and looking for a job. In 2007, retail was the largest employing industry in the State, providing jobs for 97,700 workers (NHES 2009). New Hampshire does not tax personal income, sales, inventory, capital gains, personal property, machinery, or equipment. This contributes to its competitive status in the retail industry. In 2007, the State median income was \$67,576 (NHES 2009).

In 2007, 38 percent of the workforce in Rockingham County was employed in management, professional, and related occupations, while 27 percent filled sales and office occupations. The remaining workforce was divided among service occupations including production, transportation, and material moving; and construction, extraction, maintenance and repair occupations. The primary industries in the county are educational services, health care, and social assistance, and retail. The Great Bay Estuary is important to local and regional recreational and commercial fisheries (Jones 2000). In 2007, the median household income in Rockingham County was \$72,600 (USDOC 2007).

In the region around Great Bay Refuge, the major economic participant is the Pease International Tradeport. The Tradeport is a 3,000-acre business and aviation industrial park located at the former Air Force Base that was developed by the Pease Development Authority (PDA) after the closure of the base in 1991. It has more than 200 tenants, 5,100 employees, and 3.9 million square feet of new construction and renovated space for businesses (Greater Portsmouth Chamber of Commerce 2006). The Tradeport also includes the Portsmouth International Airport at Pease which is used both for military aviation by the New Hampshire Air National Guard and for civilian aviation.

The PDA has marketed the Tradeport as an ideal location for businesses interested in global trade because of its proximity to major highways, an international airport, and the marine Port of New Hampshire. Companies located at the Tradeport also benefit from the State’s lack of a broad-based tax system. Some of the amenities provided by the Tradeport include hotels, restaurants and banquet facilities, golfing, personal and commercial banking, copy and printing services, and job training and continuing education (PDA 2006).

The expanding business center of the city of Portsmouth is less than 1 mile away from the Tradeport. Portsmouth is a significant commerce center in New



Matt Poole/USFWS

*Cattails on Stubbs Pond*



England (GPCC 2006). In addition to being accessible by five major highways, Portsmouth is served by the Boston and Maine Railroad. It is New Hampshire's only ice-free deep-water port with a Foreign Trade Zone. Lumber, fuel oils, salt, gypsum, scrap metal, and other materials are shipped from the Tradeport.

PSNH's wood burner along the Piscataqua River in Portsmouth is another major part of the economy. As mentioned before, it uses over 400,000 tons of wood chips annually to run, most of which comes from suppliers in New Hampshire (<http://www.psnh.com>; accessed May 2011).

Portsmouth is also home to many shops, businesses, galleries, museums, restaurants, and the Portsmouth Naval Shipyard, which has been in operation since 1800. As the second oldest city in the State, Portsmouth has a prominent cultural heritage that attracts many visitors to historic sites such as Strawberry Banke. In nearby Durham, UNH adds to the vitality of the area's social and cultural resources.

### Resource-based Recreation and Tourism

The natural beauty of New Hampshire has attracted many visitors to its mountains, forests, lakes, and seashore. Visitors to the State have cited visiting beaches, State parks or national forests, and opportunities for hiking, skiing, wildlife watching, and outdoor recreation as reasons for visiting New Hampshire (INHS 2009a). Tourism is an important economic contributor in New Hampshire, as 10 percent of private sector employees work in the "accommodation and food services" sector (NHES 2009). The tourism industry has seen a recent slowing due to the larger economic slowing of the country, however, meals and rooms taxes paid by tourists grew 2.3 percent in 2008, totaling \$132.9 million (INHS 2009b).

The conservation of open spaces and their associated wildlife recreation activities provide economic benefits to the local and regional community. A report by the Trust for Public Land (TPL) titled "The Economic Benefit of Parks and Open Spaces" found that throughout the nation, parks, protected rivers, scenic lands, wildlife habitat, and recreational open space help support a \$502-billion tourism industry (TPL 1999). In New Hampshire, the estimated annual value of open space to the economy totaled \$8 billion, representing 25 percent of the State's local economy and contributing \$891 million in State and local taxes (TPL 1999).

Another report by the Service found that national wildlife refuges in the lower 48 States attracted 34.8 million visitors in 2006 and generated \$1.7 billion of sales in regional economies (Carver and Caudill 2007). Wildlife refuges, such as Great Bay Refuge, provide an opportunity to generate revenue through recreational activities. In 2006, the combined total revenues from wildlife watching, fishing, and hunting in New Hampshire was \$520 million (USFWS and USDOC 2007) (table 3.6).

**Table 3.6. Revenues from Wildlife-associated Recreation by Residents and Non-residents in New Hampshire.**

Activity	Total Participants	Total Expenditures	Total Participants	Total Expenditures
	2001		2006	
Wildlife watching	450,000	\$200,010,000	710,000	\$273,769,000
Fishing	164,000	\$186,436,000	230,000	\$172,413,000
Hunting	53,000	\$55,775,000	61,000	\$74,467,000
<b>Totals</b>	<b>667,000</b>	<b>\$442,221,000</b>	<b>1,001,000</b>	<b>\$520,649,000</b>

*From the U.S. Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau. 2001 and 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.*

## Part II. The Refuge and its Resources

### Refuge Administration

#### Staffing and Budget

When the refuge first opened in 1992, its staff consisted of a refuge manager, assistant manager, and an office administrative assistant. A biological technician was also on staff for a few years. In 2006, the Service implemented a Regional Workforce Plan which included a decision to de-staff Great Bay Refuge. Since 2008, Great Bay Refuge has been administered by Parker River Refuge in Newburyport, Massachusetts (see table 3.7).

**Table 3.7. Refuge Staffing and Budget, 2005 to 2011.**

<b>Fiscal Year</b>	<b>Total Budget (Including Salaries)</b>	<b>Full-Time Staff</b>
<b>2005</b>	\$135,800	1
<b>2006</b>	\$159,410	1
<b>2007</b>	\$264,336	1
<b>2008</b>	\$124,857	0.33
<b>2009</b>	\$61,108	0*
<b>2010</b>	\$67,740	0*
<b>2011</b>	\$65,240	0*

*\*Note: Staff from Parker River Refuge administers Great Bay Refuge.*

#### Refuge Facilities

From 1992 through the summer of 2001, the refuge headquarters was located on the second floor of the former Newington Town Hall on Nimble Hill Road in Newington. The current headquarters was built in 2001, and is located past the electronic gate at the refuge entrance on Merrimack Drive, next to the former Weapons Storage Area. The automated entrance gate is timed to be open from dawn to dusk. The headquarters building houses staff space, a reception area, and a small meeting room. This office also provides office space for two regional Service staff: a regional wildlife biologist and a regional Geographic Information Systems (GIS) specialist. Map 3.2 displays the existing location of facilities.

Other refuge facilities include a house, maintenance building, and a visitor parking lot with adjacent interpretive kiosk, public restroom facility, and bicycle rack. Two pedestrian trails leave from the parking lot. These trails are described in more detail under the subheading “Public Use Programs” below.

#### Refuge Revenue Sharing

National wildlife refuges also directly contribute to local economies through shared revenue payments. Federally owned land is not taxable; but, under the provisions of the Refuge Revenue Sharing Act, the Service pays annual refuge revenue sharing payments to municipalities or other local units of government where there are national wildlife refuges. Land in public ownership requires little in the way of services from municipalities, yet it provides valuable recreational opportunities for local residents. Table 3.8 lists the payments made to the town of Newington since 2000.

Map 3.2. Great Bay National Wildlife Refuge Existing Conditions



**Table 3.8. Great Bay Refuge’s Refuge Revenue Sharing Payments to the Town of Newington, 2000 to 2010.**

Fiscal Year	Newington, NH	Fiscal Year	Newington, NH
2000	\$36,277	2006	\$36,922
2001	\$37,028	2007	\$35,702
2002	\$41,550	2008	\$27,699
2003	\$39,935	2009	\$26,028
2004	\$35,323	2010	\$18,340
2005	\$39,892		

### Special Use Permits

The refuge manager issues special use permits on a case-by-case basis after determining whether a use is compatible with refuge purposes. All special use permits have a 1-year term. The refuge has issued special use permits for the following types of activities:

- Wildlife Inventories and Research.
  - ✱ Christmas Bird Counts (New Hampshire Audubon).
  - ✱ Wood wasp trapping (U.S. Forest Service).
  - ✱ Dragonfly surveys.
  - ✱ Study of contaminant effects on frog development (UNH).
  - ✱ Owl surveys (New Hampshire Audubon).
  - ✱ Research on prescribed burns and mowing (UNH Graduate student).
- Educational Programs.
  - ✱ Cub scout merit badge tour.
  - ✱ UNH Video Services for educational films and television programs.
  - ✱ UNH fire ecology class field trip.
  - ✱ UNH geology class field trip.
  - ✱ UNH wetlands delineation class.
  - ✱ Nashua Fish Hatchery education exhibit collecting fish and vegetation.

### Research

Refuge staff, graduate students, conservation organizations, and others have conducted numerous studies on the refuge. A sampling of those efforts follows. Additional information on these studies can be obtained from refuge headquarters.

*Great Bay National Wildlife Refuge Fish Survey Report (Brown 2008).* In the fall of 1992, the Service’s Laconia Office of Fishery Assistance conducted a survey of fish present in the refuge’s three ponds. They conducted surveys at Upper Peverly, Lower Peverly, and Stubbs Ponds using an 18.0 foot long (5.5 m) electrofishing boat (boom-type with direct current). In 2007, they repeated the survey to determine if there were any significant changes in fish species composition and abundance.

*Forest Health Assessment of Great Bay National Wildlife Refuge (2007).* In the summer and fall of 2006, the U.S. Department of Agriculture (USDA) Forest Service, Durham Field Office–Forest Health Protection staff conducted an assessment of the general overall health and condition of the refuge’s forested areas. Appendix H includes their final Forest Health Assessment report.

*Geological Assessment of Cores from the Great Bay National Wildlife Refuge (2007)* In 2006, U.S. Geological Survey (Foley et al. 2006) sampled two wells on the refuge to analyze geological sources of arsenic and zinc in ground and surface waters.



*Estimating Egg Mass Abundance of Pool-breeding Amphibians (2003).* In 2002 to 2003, a regional study estimated the numbers of wood frog and spotted salamander egg masses in three to four pools on the refuge (Evan H. Campbell Grant et al. 2005).

*Investigation of Frog Abnormalities on National Wildlife Refuges in the Northeast U.S (2003).* From 1997 to 2001, the Service conducted a regional study to determine if any national wildlife refuges had sites with frequently observed frog abnormalities. The study evaluated if the prevalence of abnormalities at a site was consistent within a season and among years, as well as investigated possible causes for abnormalities.

*Field Metabolic Rate of Wild Turkeys in Winter (Coup and Perkins 1999).* Coup and Perkins (1999) used the refuge as the primary study site to investigate the field metabolic rate of free-ranging eastern wild turkeys.

## Refuge Natural Resources

### Topography and Soil

The refuge's topography is typified by gently rolling coastal hills ranging in elevation from sea level to 100 feet above sea level. The refuge has a variety of soil types, mostly from marine and glacial parent materials. The most common soil type on the refuge is Boxford silt loam, and much of the rest of the refuge is sandy and silty loams. Table 3.9 describes the major soil types on Great Bay Refuge.

For more detailed information on the area's soils, visit the Web Soil Survey online at: <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm> (USDA-NRCS 1994; accessed May 2012). The Web Soil Survey application allows users to generate soil maps for locations throughout the United States, as well as read detailed soil descriptions.

**Table 3.9. Major Soil Types on Great Bay Refuge from the Soil Survey of Rockingham County (USDA-NRCS 1994).**

Soil Name	Soil Use and Vegetation	Soil Composition	Parent Material	Slope	Drainage
<b>Boxford</b>	Most areas are either forested or used for growing forage crops for livestock, silage corn, and vegetables. Some areas are used for urban structures. Dominant tree species are white pine and a mixture of northern hardwoods.	Silt loam	Marine	0 to 8 percent	Moderately well-drained
<b>Smoothed Udorthents</b>	Most areas are used for urban development, landfills, or left idle.	—	Anthropogenic	—	Not rated
<b>Pennichuck Channery</b>	Gently sloping areas are used for row crops, truck, farming, grassland, and orchards. Sloping areas are used as orchards, grassland, and woodland. Forested areas are mostly white pine, red oak, white oak, red maple, and sugar maple.	Very fine sandy loam	Glacial till	0 to 15 percent	Well drained



Soil Name	Soil Use and Vegetation	Soil Composition	Parent Material	Slope	Drainage
<b>Hoosic</b>	Most areas have been cleared and are used for pasture or to grow hay, corn, small grains, vegetable crops, and deciduous fruit. Forested areas contain sugar maple, oak and hickory species, and American beech.	Fine sandy loam	Glacial outwash	3 to 15 percent	Somewhat excessively drained
<b>Squamscott</b>	Most areas are forested. Principle trees are white pine and red maple. Some areas that are drained are in cropland.	Fine sandy loam	Marine	0 to 5 percent	Poorly drained

### Habitat Types and Associated Wildlife

Despite its relatively small size, Great Bay Refuge supports a diversity of habitat types (table 3.10). The upland and freshwater habitats of the refuge include oak-hickory forest, shrublands, grasslands, forested and shrub wetlands, and impounded wetlands. The refuge is 60 percent upland forest or rocky upland, 18 percent grassland or shrubland, and 22 percent freshwater or saltwater wetland, including open water and forested wetlands. The refuge also has a small amount of rocky shoreline and salt marsh habitat. Maintaining these habitat types on the refuge contributes to the protection of critical habitats throughout the Great Bay Estuary.

**Table 3.10. Natural Community Types and Associated Habitats on Great Bay Refuge.**

Habitat	Habitat Acres	Natural Community Type	Acres
Salt marsh	36	High salt marsh	23
		Low salt marsh	6
		Low/high salt marsh complex	5
		Brackish marsh	2
Rocky shoreline	2	Coastal rocky headland	2
Freshwater impoundments	62	Open-basin cattail marsh	45
		Open water/beaver impoundment	14
		Tall graminoid emergent marsh	3
Forested and scrub-shrub wetlands and vernal pools	149	Low red maple–elm/musclewood/ladyfern silt forest	69
		Seasonally saturated red maple swamp	38
		Black gum–red maple basin swamp	14
		Speckled alder basin/seepage shrub thicket	12
		Red maple–sensitive fern-tussock sedge basin/ seepage	12
		Graminoid-forb-sensitive fern seepage marsh	2
		Wet gravel pit-artificial pondshore	<1
		Short graminoid-forb meadow marsh/ mudflat	<1

Habitat	Habitat Acres	Natural Community Type	Acres
Oak-hickory forest	659	Mesic Appalachian oak–hickory forest	375
		Dry mesic Appalachian oak–hickory forest	147
		Dry Appalachian oak-hickory forest	90
		Plantation	25
		Forest on fill	12
		Red pine forest woodland	8
		Dry-mesic field/shrubland; reverting to forest	2
Shrubland	26	Dry-mesic field/shrubland	23
		Mesic field/shrubland	3
Grassland	169	Dry field	95
		Dry to wet field mosaic	19
		Dry-mesic field	55
TOTAL			1,103

*\*Table summarized by refuge staff based on field visits by Sperduto (2000, 2010) and GIS analysis. Acres rounded up to nearest whole number.*

In 2000 and 2010, the New Hampshire Natural Heritage Bureau (NHB) identified and mapped natural community types and other cover types on the refuge (Sperduto 2000 and 2010) (map 3.3). Natural communities are recurring assemblages of plants found in particular physical environments that are distinguished by three characteristics: 1) a definite plant species composition; 2) a consistent physical structure (such as forest, shrubland, or grassland); and 3) a specific set of physical conditions (such as different combinations of soils, nutrients, drainage, and climate conditions). Most wildlife species do not select habitats on as fine a scale as natural community types. Therefore, we have combined some of the natural community types with broader wildlife habitat types. Both classifications are important to understanding and maintaining the refuge's biological diversity, integrity, and environmental health.

Exemplary natural communities are those that have been minimally impacted by humans, contain a species composition representative of the type, and have intact ecological processes that maintain these species. The NHB identified the following five “exemplary” natural communities on Great Bay Refuge (<http://www.nhdf.org/natural-heritage-and-habitats/>; accessed December 2011):

- Dry Appalachian oak–hickory forest.
- Mesic Appalachian oak–hickory forest.
- Coastal rocky headland.
- Black gum–red maple basin swamp.
- High salt marsh.

The refuge also supports an additional rare natural community type: red maple–elm–lady fern silt forest. In 1999, NHB mapped several stands of this community on the refuge, but, at that time, none of them were considered “exemplary” because they were relatively young and had significant infestations of invasive plants. However, these stands are still important for the refuge because the community type is rare in New Hampshire (critically imperiled/imperiled in New

Great Bay National Wildlife Refuge - Comprehensive Conservation Plan

Great Bay National Wildlife Refuge  
Existing Natural Vegetation Communities

Welsh Cove

Observation Platforms

Hog Sty Cove

Thomas Point

Muddy Point Field

Saddle Pond

Thomas Field

Herods Cove

Nanny's Island

Atlantic Ocean

Atlantic City Expressway

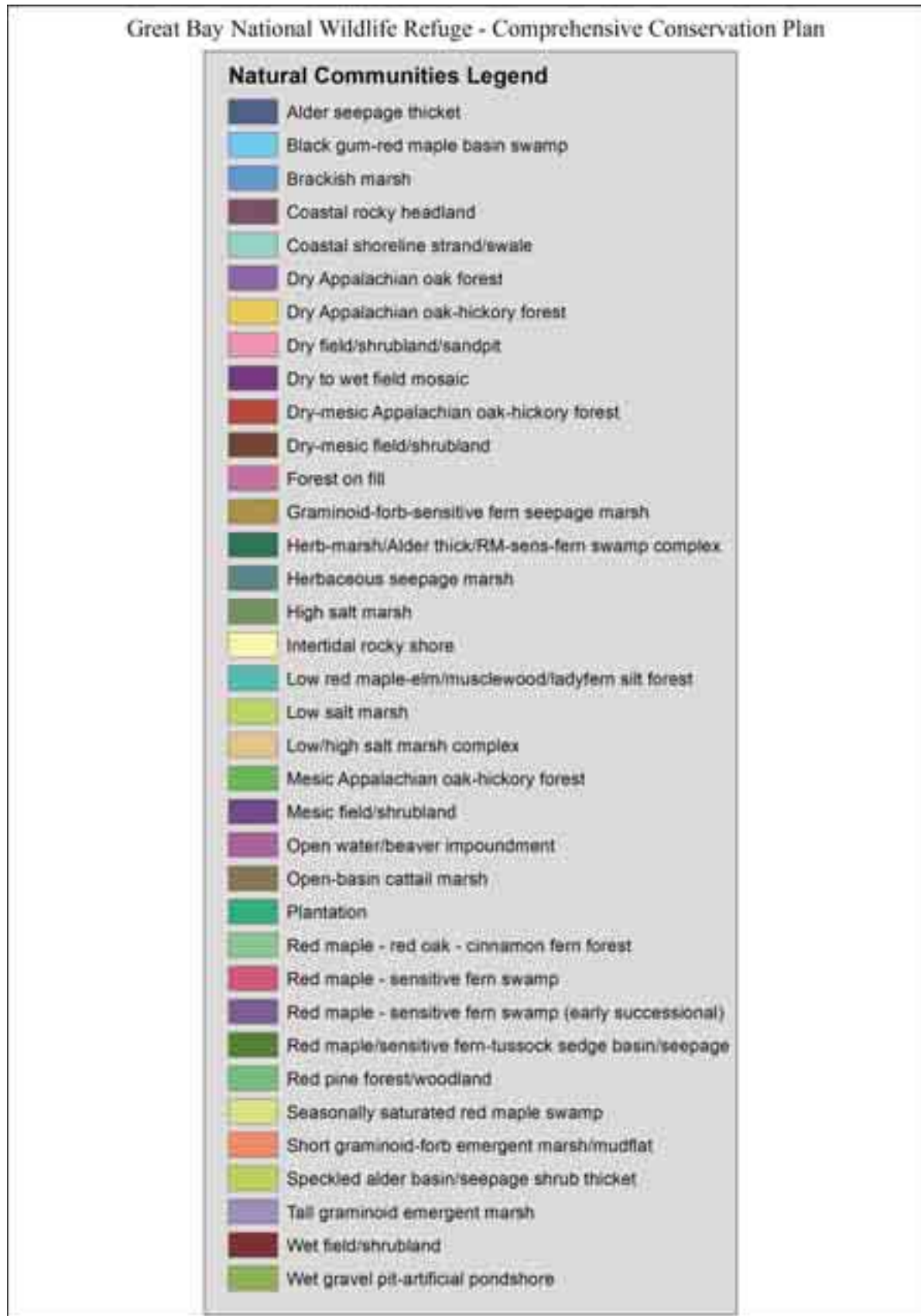
Scale: 0 0.25 0.5 0.75 Miles

Scale: 0 0.25 0.5 1 Kilometers

North Arrow

Source:  
Vegetation Community data from  
the National Wetlands Program.  
Vegetation Community data from  
the National Wetlands Program.  
Range, Boundary, and Information  
data from USFWS.  
Background image from Google Earth.

## Legend for Map 3.3





Hampshire) and there are no documented “exemplary” occurrences of red maple-elm-lady fern silt forest in the State (Bowman 2012 personal communication).

## Estuarine Habitats

### Salt Marsh

Several areas of substantial salt marsh, totaling approximately 36 acres, occur along the refuge’s shore, with the best developed occurring behind Woodman Point and Stubbs Pond. The low salt marsh is dominated by smooth cordgrass, while salt meadow cordgrass, spike grass, and black-grass are dominant in the high salt marsh. Small brackish marshes occur at the upland edge of salt marshes where drainages meet the bay, and are dominated by narrow-leaf cattail and sedge species. NHB reported several rare plants in the refuge’s salt marsh, including seaside mallow, a State-listed threatened species (NHNHB 2009). Estuarine communities are uncommon in New Hampshire because of the limited shoreline within the State and the intense development and disturbance near much of the coastal salt marsh.

In 1992, prior to refuge establishment, the town of Newington hired a contractor to spray the pesticide *Bacillus thuringiensis* serotype *israelensis* (Bti) on marshes to control the extensive mosquito breeding occurring in areas of the marsh heavily impacted by humans. Beginning in 1996, in an effort to eliminate chemical application on the marshes and restore fish and wildlife habitat, the refuge initiated four open marsh water management (OMWM) projects. In total, 16.3 acres were completed at Herods Cove, 9.9 acres at Woodman Point, and 3.4 acres at Welch Cove. We have not created any additional OMWM projects since then, as we have completed all the opportunities for OMWM on the refuge.

OMWM objectives included elimination of invasive plants (e.g., *Phragmites*, cattail); restoration of native salt marsh vegetation, such as wigeon grass; and creation of refugia habitat for the mummichog minnow. This minnow is a predator of mosquito larvae and its presence could eliminate the need to spray Bti for mosquito control. Various techniques were used. Ditch plugs were constructed to block man made drainage ditches and create open water habitat. Pannes (beginning at 2 inches and gradually sloping to 24 inches in depth) were excavated to increase open water habitat and to facilitate wading bird access. Sumps (2-foot-deep depressions) were excavated within pannes to ensure minnow survival during drought conditions. In some areas, shallow connector ditches were also excavated to allow minnow access between pannes.

### Rocky Shoreline

Woodman Point and Thomas Point support approximately 2 acres of southern New England coastal rocky headland, considered a rare exemplary community type by NHB. The headlands have a largely natural character with narrow vegetation zones representing both estuarine and upland plant associations. The upland portion at Thomas Point is dominated by red cedar and some black oak, red oak, alders, bayberry, and common juniper. The salt marsh and rocky areas of the point support estuarine plants such as seaside goldenrod (NHNHB 1990).

Large red and white pines grow on the headlands, providing important perch and roost trees for bald eagles wintering on Great Bay. The refuge has suitable eagle nest sites, although there is currently only one eagle nest on Great Bay Refuge. Two red pine forests (approximately 4 acres each) are found by Woodman Point and west of the Margeson Estate. These pines are estimated to be about 150 years old and are natural communities disjunct from larger patches found primarily in the White Mountains region (Sperduto 2010).

The 0.25-acre Nannie Island off Woodman Point is the only island that is part of the Great Bay Refuge. A mallard pair occasionally nests on the island. Some



invasive plants are present. The island was evaluated for tern nesting possibilities but was deemed unsuitable because of its small size and susceptibility to predation and human disturbance.

### Eelgrass and Shellfish Beds

Two other regionally significant habitat types lie just off the refuge boundary in State waters: eelgrass beds and shellfish beds. Their protection is a priority amongst partners in the Great Bay Estuary. Refuge staff, as a partner in these protection efforts, conduct informal monitoring to evaluate if refuge management actions are impacting these habitats.

Eelgrass beds are an essential habitat in the Great Bay Estuary and the basis of an estuarine food chain, providing food for migrating and wintering waterfowl and habitat for juvenile fish and invertebrates. Eelgrass beds are particularly important to juvenile rainbow smelt, Atlantic silversides, nine-spined sticklebacks, alewife, and blueback herring. Eelgrass leaves slow water flow, filtering suspended sediments from the water column (Short et al. 1992a). A dramatic decline in eelgrass beds in 1989, to only 300 acres, was linked to an outbreak of the *Labryrinthula zosterae* slime mold, commonly called “wasting disease.” Eelgrass populations recovered from the disease but have been showing a slow steady decline since 1990 (PREP 1999). Reduced water clarity from suspended sediments, nutrient loading, and decreased filtering capacity may be contributing to eelgrass populations decline. This is an ongoing management issue in Great Bay Estuary (Short et al. 1992b). A significant eelgrass bed exists in Herods Cove, part of which is adjacent to the refuge boundary.

The Great Bay Estuary and its tributaries support 52 acres of oyster beds, over 2,500 acres of scattered clam flats, and significant areas with blue mussel beds, razor clams, and scallops. Soft-shell clams are an important food source for wintering black ducks. The estuarine habitat extending from Herods Cove to Nannie Island is an important nursery area for oysters and clams, supporting more than half of the spawning oyster population in the bay (PREP 2009).

Pondside color



Matt Poole/USFWS

### Freshwater Impoundments

#### Historical Uses

The refuge has five freshwater impoundments: Lower Peverly Pond, Upper Peverly Pond, Stubbs Pond, and two small impoundments in the Weapons Storage Area and along Ferry Way Trail. Upper Peverly Pond (12 acres), Lower Peverly Pond (7 acres), and Stubbs Pond (44 acres) are interconnected by Peverly Brook and fed by springs and small tributaries. These impounded wetlands are part of the 907-acre Peverly Brook watershed.

Upper and Lower Peverly Ponds were constructed as a water supply for the city of Portsmouth around 1900. From 1956 to 1959, the dike between the two ponds was improved with a spillway and a new dam. At the same time, Lower Peverly Pond was dredged to provide a swimming area and the water control structure boards were raised 3 feet. Maps 3.4 through 3.6 are aerial photographs that show these changes to the freshwater impoundments from 1952 to 1998 (Public Archaeological Laboratory, 2010).

The Air Force used Upper Peverly Pond for boating and angling, and used Lower Peverly Pond as a recreational swimming pond. Stubbs Pond area was a salt marsh until it was diked for mosquito control in 1963. Several years later, the dike was raised to provide for a warm water fishery and the pond was named after General Stubbs. The Air Force managed vegetation in all three ponds to improve recreational fish habitat. They also stocked the three ponds with recreational fish (table 3.11). No stocking has occurred since the refuge was

Map 3.4. Great Bay National Wildlife Refuge Area–July 1952



*Map 3.5. Great Bay National Wildlife Refuge Area–October 1962*





Map 3.6. Great Bay National Wildlife Refuge Area–Circa 1998



established in 1992. Table 3.18 provides a description of the current fisheries resources in these ponds.

Prior to 1980, the Air Force's impoundment management generally consisted of herbicide application. Records indicate that Upper and Lower Peverly Ponds were treated with Diquat in 1966. Generally, management activities were not documented; however, a 1980 Fishery Management Plan by the Air Force stated that annual programs to control algae growth in all three ponds were implemented. The 1980 plan recommended minimizing the application of herbicides and suggested mechanical control instead. In 1979, 7 acres of Stubbs Pond were mechanically cleared. In the 1980s, plastic tarps were placed over weeds in Stubbs Pond to prevent further growth, but it appears that the tarps were largely ineffective. During the 1980s, vegetation (documented as *Chara spp.*) was estimated to be covering 90 percent of the surface area of Stubbs Pond. Sometime in the last several decades, wild rice was introduced to Stubbs Pond and has become well established and abundant. Wild rice, which is uncommon in the State, is an important source of food and cover for wildlife (NHFG 2012 personal communication).

**Table 3.11. Fish Stocking During Air Force Management of Upper Peverly, Lower Peverly, and Stubbs Ponds.**

Pond	Year Stocked	Species
Upper Peverly	1956	Rainbow and brook trout
	1965 and 1966	Largemouth bass
	1972	Crayfish
Lower Peverly Pond	1956	Rainbow and brook trout
	1965 and 1966	Largemouth bass
Stubbs Pond	1965 and 1966	Largemouth bass
	between 1971 and 1981	Alewife (stocked 4 times)
	1972	Crayfish

Source: Great Bay Refuge Fisheries Management Plan, 1994.

#### *Stubbs Pond (Recent Management)*

The 44-acre Stubbs Pond is a freshwater impoundment currently managed primarily for migratory birds, with a focus on spring and fall migrating waterfowl. The goal is to control the monoculture of cattail vegetation, and to increase vegetation diversity by opening up areas and increasing the ratio of open water to emergent vegetation while controlling invasive purple loosestrife and phragmites. Water level management has fluctuated from year to year, in part because of the complexities in managing Stubbs Pond to address multiple concerns. Large bur-reed, a State threatened species, has been found in the pond.

Since the installation of a new water control structure in 1996, cattail growth has been excessive, reducing the proportion of open water to vegetation. Mowing and re-flooding were used beginning in 1997 to reduce cattail coverage. In 1999, water levels were not dropped until August, and moist soil vegetation production was poor. Subsequently in 1999, the tidal gates were opened October 26 and closed on December 1 to coincide with extremely high tides to create a tidal flush as recommended by Leigh Fredrickson of the University of Missouri (Fredrickson 1999 personal communication). Fredrickson also recommended



treating a small (10 acre) area of cattails with glyphosate. However, due to permits required by the State of New Hampshire, the planned glyphosate treatment was pushed back until August of 2000.

In the summer and early fall of 2002, Stubbs Pond was drawn down to allow mowing of 4 acres of cattail along the western edge of the pond and west of the main water channel. During late fall of 2002, we blocked all three pipes that run under the dike at Stubbs Pond to allow water levels to rise and be held at higher levels than allowed by the water control structure. When the pipes are open, water levels can never exceed approximately 6 to 6.5 feet on the water control structure gauge. With all boards in place, water levels rose over the winter to around 7.0 feet. Stubbs Pond was kept as full as possible, between 7.1 and 7.3 feet, throughout the summer of 2003 in an attempt to control cattail growth. By late August the cattail stands were reduced by 25 percent. The entire southeastern quadrant of Stubbs Pond, normally full of cattail, remained almost cattail free. The western portion of the pond that was mowed in the fall of 2002 had some cattail reemerge during the summer, with some small pockets of open water. We also observed increased populations of other plant populations important for wildlife, including large bur-reed, soft stem bulrush, wild celery, and arrowhead. There were also fewer purple loosestrife plants in bloom during mid to late summer.

On September 11, 2003, the refuge staff began to lower the water level in Stubbs Pond to provide some feeding habitat for migrating birds. By mid-November the water level was 4.3 feet. Dead cattail stems were evident in many areas of the pond as water levels were drawn down. On November 18, all boards were put back in the control structure to allow water to rise to full pool over the winter.

During 2004, water levels in Stubbs Pond were again maintained at an operating level of around 7.0 feet during the spring and summer in an effort to further stress growth of cattail. This effort was apparently successful and reduced cattail populations another 25 percent. Cattail stands were now limited to several larger clumps around the center island and along the northwestern and eastern edges of the pond. On September 10, the refuge staff began lowering the water levels to provide habitat for the fall bird migration. Water levels reached a low of 3.4 feet on November 17, when all boards were put back in to allow the pond to raise to full pool over the winter.

It appears that spring drawdown of this pond allows cattail and purple loosestrife to increase, while inhibiting other more desirable species. Therefore, current plans are to keep Stubbs Pond high during the spring and summer to discourage cattail growth. A drawdown in early fall benefits migratory birds. If weather permits, it may be possible to mow, spray, or burn cattail stands in the fall before refilling the pond in the winter to early spring.

Stubbs Pond and the adjacent bay are important migratory and wintering habitat for waterfowl. It is a particularly important to area waterfowl during spring and fall staging as evidenced by the number and variety of waterfowl species observed on the pond, particularly black ducks. However, no regular or formal quantitative surveys for waterfowl use have been conducted by the refuge or the State. In winter of 2010, Parker River staff recruited volunteers to start formal surveys for all three impoundments during spring and fall waterfowl migration. Two surveys were conducted in December and four surveys in April. Table 3.12 lists the most abundant waterfowl species recorded during the survey.

*Stubbs Pond*

Previous observational data indicates that waterfowl use of Stubbs Pond is highest in fall (September to November). NHFG (2011) has also reported that it is common to observe more than 500 ducks and geese in Stubbs Pond in September. Due to this, NHFG and the Service use Stubbs Pond for an important waterfowl banding program during Septembers. Winter peak waterfowl use is comparatively higher in the bay (a total of 676 individuals; most common species are Canada goose, American black duck, and mallard) than in Stubbs Pond (94 individuals). However, waterfowl use of Stubbs Pond is higher than that of the bay during the springtime.

**Table 3.12. Most Common Species Detected During Waterfowl Survey of Stubbs Pond, 2010.**

Month	Species	Number Observed
April 2010	Ring-necked duck	100
	Ruddy duck	94
	Wood duck	14
	American wigeon	12
	Canada goose	10
December 2010	American black duck	50
	American coot	20
	Mute swan (nonnative)	17
	American wigeon	6

The amount of emergent wetland habitat has declined significantly throughout North America along with apparent declines of marsh-dependent birds. Between 1999 and 2003, five marsh bird surveys were completed for the refuge. Virginia rail (0 to 5 birds per survey) and marsh wren (2 to 9 birds per survey) were consistently found using the impoundments. Other species that occasionally bred in the impoundments included least bittern, sora rail, common gallinule, pied-billed grebe, and king rail. Most of the marsh and wading birds occurred at Stubbs Pond. Our strategy at Stubbs Pond of maintaining a balance of open water to emergent vegetation with an emphasis on vegetative diversity provides the most benefit to a majority of marsh and wading birds. Changes in water levels, ratios of mud flats to open water areas, invertebrate communities, and amount of emergent plant cover in marsh habitats could affect habitat quality for marsh birds.

In 2002 and 2006, an evaluation of all three dams on Upper and Lower Peverly Ponds and Stubbs Pond occurred. According to the 2006 Safety Evaluation of Existing Dams (SEED) report, Stubbs Pond Dam is in “poor” condition. Poor condition is defined by “a potential dam safety deficiency is clearly recognized for normal loading conditions. Corrective actions to resolve the deficiency are recommended.” The “poor” rating for Stubbs Pond Dam was primarily due to two deficiencies: erosion around three steel pipes embedded in the dam’s embankment, and the presence of vegetation in the dam’s emergency spillway. Continued deterioration of Stubbs Pond would likely jeopardize the refuge’s ability to maintain the pond as open water habitat for migratory birds (Brownell 2011 personal communication). The following specific recommendations from the 2006 SEED report are being addressed as noted below.

Recommendations	Refuge Actions in Response
Remove 3 steel pipes that lie embedded in the embankment and backfill the area	Future project targeted by 2014
Mow embankments, remove trees and other debris from spillway	Ongoing
Remove brush and debris on dam and side slopes	Ongoing
Install riprap in emergency spillway where needed	Future project targeted by 2014
Enlarge emergency spillway and left abutment; consider doing this during brush and debris removal and riprap installation	Evaluating
Repair wave erosion on escarpment near Herods Cove	Monitoring, but repairs would conflict with horseshoe crab spawning habitat

A fish passage structure was installed in 1995 to benefit alewife and blueback herring migration, but was not operated until the spring of 2003. Historically, we have opened the fish passage in late April to allow alewife and blueback herring migration into Stubbs Pond through early July. The fish passage structure requires about 1 to 1.5 feet of running water to be effective for fish. It is primarily designed to operate at high tides since tidal mud flats in Herods Cove at low tide prevent fish reaching the ladder. Outside of fish spawning season, the fish ladder is essentially not operational by design. In fact, there are times of the year when no water is flowing through the fish ladder. We have plans to evaluate this original design to see if the existing fish ladder could be improved

to enhance fish passage. Operation of the fish ladder does not impact our ability to manage water levels in Stubbs Pond for migratory birds, except possibly in extremely dry years (Brownell 2011 personal communication).

*Upper Peverly Pond (Recent Management)*

A new water control structure was installed on the 12-acre Upper Peverly Pond in 1999. The pond was drawn down several times during spring with positive vegetative and waterfowl population response to this management. During 2004, a botanist inventorying the refuge for invasive species discovered that brittle waternymph had become widely established in the pond. Brittle waternymph is an annual exotic plant with no easy control methods. The water level in the pond was held high all year to contain this invasive plant until more is determined on how to control it. It is used by a limited number of waterfowl and marsh birds such as great blue heron, ring-neck duck, wood duck, and bufflehead for foraging and resting during migration. According to the 2006 SEED report, Upper Peverly Pond Dam is in “fair” condition. Fair condition is defined by “no existing dam safety deficiencies are recognized for normal loading conditions. Infrequent hydrologic and/or seismic events would probably result in a dam safety deficiency.” The following specific recommendations from the 2006 SEED report are being addressed as noted below.

<b>Recommendations</b>	<b>Refuge Actions in Response</b>
Remove beaver dams from spillways	Ongoing
Weld or lock cover on outward valve	Done
Back fill existing animal burrows	Not needed
Lubricate valves	Done
Monitor seepage along abutment	Monitoring
Monitor crack and depression on dam	Monitoring
Remove debris and maintain embankment	Ongoing as needed and as resources allow

*Lower Peverly Pond (Recent Management)*

The 7-acre Lower Peverly Pond has limited water control capabilities given that its antiquated spillway is deteriorating. In 2005, plans were developed to repair the dike; however, the State denied the permits requesting further documentation of the need for repairs versus removal of the dam. Without water control capability, this pond is used primarily to pass water from Upper Peverly to Stubbs Pond. Brittle waternymph was found in this pond in 2004. Lower Peverly Pond supports a limited number of waterfowl, notably some wood ducks and black ducks. An occasional bufflehead, common merganser, and a few ring-necked ducks can be observed during the spring and fall migration.

According to the 2006 SEED report, Lower Peverly Pond Dam is in “unsatisfactory” condition. Unsatisfactory condition is defined by “immediate actions to rehabilitate or decommission the dam are recommended.” The “unsatisfactory” rating for Lower Peverly Pond Dam was primarily due to one deficiency: the deteriorating and failing spillway. The following specific recommendations from the 2006 SEED report are being addressed as noted below.

Recommendations	Refuge Actions in Response
Monitor and inspect failing spillway weekly	Ongoing, but not weekly
Monitor beaver activity and remove debris from spillway	Ongoing
Remove trees and brush from embankment	Determined not necessary
Rehabilitate or decommission dam	See chapter 4, objective 1.3 under each alternative for proposed actions

### Forested and Scrub-shrub Wetlands and Vernal Pools

Several vegetated wetlands habitat types occur on the refuge as noted in table 3.10. Approximately 81 percent of the wetlands types on the refuge are dominated by trees, mainly red maple and some black gum. The remaining 19 percent of vegetated wetlands is shrub-scrub wetlands dominated primarily by speckled alder. Map 3.3 shows the locations of the forested and scrub-shrub wetlands. Vernal pools, which are not mapped, are a critical habitat feature that is imbedded in each of these wetlands types.

NHB discovered a black gum-red maple basin swamp on the refuge that contains dozens of old black gum. Some of the trees were likely more than 200 years old, although a more detailed assessment is needed. Seepage swamps on the refuge have the potential for supporting rare plants (Sperduto 2000). Seepage swamps are forested wetlands with plants indicative of groundwater seepage such as spicebush, horsetail, marsh marigold, American bittersweet, and certain sedges.

In 2001, the Northeast Amphibian Research and Monitoring Initiative was launched on a host of national wildlife refuges and state parks, including Great Bay Refuge, due to increasing concern over amphibian declines and malformations. The goal of the study was to establish baseline conditions and to assess population trends of vernal pool breeding amphibians (e.g., wood frog and spotted salamander). An annual frog and toad calling survey, following the North American Amphibian Monitoring Program (NAAMP) protocol, was begun in 2000. The surveys on the refuge have yielded spring peeper, gray tree frog, wood frog, leopard frog, and American toad. Outside of this study, there has been no formal or comprehensive survey of vernal pool locations on the refuge.

The refuge records about 6 to 12 breeding American woodcock on the refuge each year. These birds use the speckled alder-shrub thickets that are scattered around the refuge for daytime resting and foraging areas. Woodcock prefer shrublands in close proximity to young hardwood forests for use as nest sites. The willow flycatcher prefers open habitat with scattered shrubs or forest edges, including willow thickets along streams, scrub-shrub wetlands, and brushy fields.

A 1-acre wetland was created in 1995 by installing a wooden water control structure to impound several drainage ditches in the former weapons storage area. This wetland holds water during the spring and early summer and goes dry during late summer. The vegetation is predominantly cattails, which support some marshbirds, such as sora and Virginia rails, plus many species of frogs.

## Upland Habitats

### Oak-hickory Forest

Many of the forests on Great Bay Refuge reflect their relatively recent agricultural history and are dominated by successional white pine or hardwoods. Although pine, hardwoods, and mixed stands are native to the area, the current overstory dominant tree species are not necessarily the best indicator of what natural community types occurred on the refuge. White pine stands are common and are generally a stronger indication of past land use history than they are of



the long-term potential of a site. NHB used the total composition of plant species, in combination with soil attributes, to indicate community type (Sperduto 2000).

In 1990, NHB surveyed the entire former Pease Air Force Base. In that survey, Woodman Point was described as a transitional forest between central and northern hardwood regions. It has large mature red pines that appear to be natural in origin. The drier portion supports large shagbark and pignut hickories, while the more mesic area has large white and red oaks (NHNHP 1990). A 2010 survey by NHB determined that the red-pine woodland is about 150 to 170 years old and is most likely a natural occurrence.

Much of the rest of the upland area of the refuge was mapped as oak-hickory forest. The natural community types include dry Appalachian oak forest and mesic Appalachian oak-hickory forest. The refuge falls within the northern extent of the central hardwoods forest region with forests dominated by oak and pine. The dry to mesic Appalachian oak forests on the refuge are characterized by southern species that reach the northern extent of their ranges in this region. It is distinguished from dry red oak–white pine forests, which tend to lack significant representation of southern or Appalachian species such as shagbark hickory. Oak forests appear to be fire-dependant over long periods in other regions of the country. Some of these forests may succeed to other overstory species in time due to lack of adequate red oak regeneration, and from increases in American beech on drier sites, and sugar maple and American beech on more mesic sites. Repeated fire would tend to knock back fire-sensitive species like American beech and sugar maple. As such, any natural, semi-natural, and/or controlled fire regimes may be necessary for the long-term maintenance of oak and hickory on some sites (Sperduto and Nichols 2004). Under climate change projections, the range of the oak-hickory forests is likely to shift northwards, making southern New Hampshire the middle of its range. This shift may preclude succession to northern hardwood as described above. Changing climate conditions may also increase likelihood of fire, which would sustain oak-hickory forests.

### **Pine Plantations**

There are five pine plantations of varying size on the refuge. These pines were dated to the late 1970s, and were most likely planted by the military as training exercises. The pines in these plantations are dying due to an unknown disease, and oak-hickory forest species are regenerating under the pine overstory. The conversion of these plantations to oak-hickory forest will be monitored to ensure a healthy forest ecosystem with minimum invasive plants.

### **Upland Shrub Habitat**

The refuge currently maintains approximately 26 acres of shrub habitat through periodic mowing or use of a hydro-ax to prevent succession to forest cover. These are mainly small units, less than 5 acres in size, and historically maintained as woodcock singing grounds. A management issue on the refuge that particularly affects grassland and shrub management is the prevalence of invasive species that quickly invade these areas if left unmowed. Autumn olive is particularly difficult invasive plant to control as it quickly invades open land habitat. Shrub habitat provides nesting and foraging habitat for birds of conservation concern including prairie warbler, blue-winged warbler, eastern towhee, and American woodcock. It also supports other thicket-dependent native species. Over the course of the next 15 years, we would let these small forest openings revert and manage for larger patches of shrub habitat that would provide better habitat for shrub-dependent birds and New England cottontail. We would also target sites where conditions are more conducive to shrub management (e.g., wet areas that naturally support alder and dogwoods).

### Grassland

The refuge currently manages approximately 169 acres of grassland habitat, primarily in the former Weapons Storage Area, north of Woodman Point, along Ferry Way Trail, and the Thomas Field. Many of these grassland areas have a component of

little bluestem as well as nonnative grasses. The largest grassland, approximately 70 acres comprised of 8 treatment areas, is in the former Weapons Storage Area. This grassland complex is managed using prescribed fire and mowing to control autumn olive and other woody plants. Most sections of the Weapons Storage Area were either mowed, hydro-axed,

or burned in 1999 to prepare for a 2000 herbicide application to control autumn olive. The hydro-ax was also used to expand the grassland by clearing trees and shrubs at the southwest end of the weapons storage area. The 30-acre Thomas Field and 24-acre Woodman Point Field complex are mowed and hydro-axed. A sandy field north of the Weapons Storage Area has maintained itself as a little bluestem community without active management for over 10 years. This field is south of the northern most pine plantation (15 acres), which also support sandy soils, and potentially could be managed as a 20- to 30-acre grassland unit, contiguous with the grasslands in the Weapons Storage Area. The remaining grassy areas range from 2 to 4 acres and are mowed every 1 to 2 years to benefit woodcock.

*Woodman Point looking north*



Greg Thompson/USFWS

Grassland bird species recorded during surveys on the refuge from 2001 to 2003 included eastern meadowlark, bobolink, upland sandpiper, field sparrow, red-winged blackbird, American kestrel, and vesper sparrow. Brown thrasher and eastern towhee, two shrubland species, were also recorded. In 2003 and 2004, at least one pair of upland sandpipers was observed using the former Weapons Storage Area and the Thomas Field during the nesting season. The Thomas Field pair was observed nesting for the second year in a row.

The Pease Airport continues to support nesting upland sandpipers due to the large expanse of grassland habitat surrounding the runways. Excluding buildings, there are approximately 500 to 600 acres of grasslands surrounding the runways and taxiways. On average, a dozen pairs of upland sandpipers have nested at the airport in recent years. The only confirmed upland sandpiper breeding areas in New Hampshire are at Pease Airport and the refuge, although the species has been sighted at several other locations including Dover, Manchester, and southern Coos County (Hunt and De Luca NH Audubon 2011 personal communication).

### Rare Plant Populations

The following four State-listed rare plants are documented on the refuge: large bur-reed, seaside mallow, black sedge, and wild lupine (NHNHP 2009).

### **Invasive Plants**

Executive Order 13112 (“Invasive Species,” dated February 3, 1999) defines an invasive species as a nonnative species “whose introduction does or is likely to cause economic or environmental harm or harm to human health.” The Executive Order requires the National Invasive Species Council (Council) to produce a National Invasive Species Management Plan every 2 years. In January 2001, the Council released their first plan, which serves as a blueprint for all Federal actions on invasive species. The plan focuses on those nonnative species that cause, or may cause, significant negative impacts and that do not provide an equivalent benefit to society. The unchecked spread of invasive plants threatens the biological diversity, integrity, and environmental health of all refuge habitats. In many cases, they have a competitive advantage over native plants and form dominant cover types, reducing the availability of native plants as food and cover for wildlife. One report estimates the economic cost of invasive species in the U.S. at \$137 billion every year (Pimentel et al. 2000). Up to 46 percent of the plants and animals federally listed as endangered species have been negatively impacted by invasive species (Wilcove et al. 1998, National Invasive Species Council 2001).

The Service’s Northeast Region initiated an effort to systematically identify, locate, and map invasive plant species occurring on national wildlife refuge lands to provide a foundation for developing an effective integrated management plan. Refuges will use this information to guide the development of control, monitoring, and evaluation projects.

The Service Manual (620 FW 1.7G) provides the following guiding principles on managing invasive species on national wildlife refuges:

1. Manage invasive species to improve or stabilize biotic communities to minimize unacceptable change to ecosystem structure and function and to prevent new and expanded infestations of invasive species.
2. Conduct refuge habitat management to prevent, control, or eradicate invasive species using techniques described through an integrated pest management plan, or other similar management plan, the plans comprehensively evaluate all potential integrated management options, including defining threshold/risk levels that will initiate the implementation of proposed management actions.
3. Evaluate native habitat management activities with respect to their potential to accidentally introduce or increase the spread of invasive species and modify our habitat management operations to prevent increasing invasive species populations.
4. Refuge integrated pest management (IPM) planning addresses the abilities and limitations of potential techniques including chemical, biological, mechanical, and cultural techniques.
5. Manage invasive species on refuges under the guidance of the National Strategy for Invasive Species Management (USFWS 2003b) and within the context of applicable policy.

Great Bay Refuge initiated a baseline inventory and mapping of invasive species in 2002. Field surveys during 2002 through 2005 and 2008 detected 34 invasive species (table 3.13). Approximately 684 acres of the refuge have been mapped as infested and 13 acres are currently considered free from invasives. The remainder of the refuge still needs to be mapped, which will occur by 2013. Invasive species control methods used by the refuge include hand pulling with weed wrenches, annual mowing, and chemical and biological controls (for purple loosestrife).

**Table 3.13. Invasive Plant Species on the Great Bay Refuge.**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Approximate Number of Refuge Acres Affected</b>
Amur honeysuckle	<i>Lonicera maackii</i>	Less than 1
Autumn olive	<i>Elaeagnus umbellata</i>	205
Black locust	<i>Robinia pseudoacacia</i>	33
Black swallow-wort	<i>Cynanchum louiseae</i>	8
Border privet	<i>Ligustrum obtusifolium</i>	Less than 1
Brittle waterlily	<i>Najas minor</i>	3
Canada thistle	<i>Cirsium arvense</i>	47
Greater celandine	<i>Chelidonium majus</i>	Less than 1
Climbing nightshade	<i>Solanum dulcamara</i>	34
Coltsfoot	<i>Tussilago farfara</i>	Less than 1
Common barberry	<i>Berberis vulgaris</i>	247
Common buckthorn	<i>Rhamnus cathartica</i>	369
Common mullein	<i>Verbascum thapsus</i>	Less than 1
Common reed, <i>Phragmites</i>	<i>Phragmites australis</i>	Less than 1
Creeping buttercup	<i>Ranunculus repens</i>	26
Creeping jenny	<i>Lysimachia nummularia</i>	Less than 1
Dames rocket	<i>Hesperis matronalis</i>	2
European privet	<i>Ligustrum vulgare</i>	105
Glossy buckthorn	<i>Frangula alnus</i>	456
Ground ivy	<i>Glechoma hederacea</i>	1
Japanese barberry	<i>Berberis thunbergii</i>	207
Japanese honeysuckle	<i>Lonicera japonica</i>	Less than 1
Japanese knotweed	<i>Polygonum cuspidatum</i>	7
Japanese wisteria	<i>Wisteria floribunda</i>	Less than 1
Leafy spurge	<i>Euphorbia esula</i>	16
Morrow's honeysuckle	<i>Lonicera morrowii</i>	57
Multiflora rose	<i>Rosa multiflora</i>	268
Oriental bittersweet	<i>Celastrus orbiculata</i>	237
Purple loosestrife	<i>Lythrum salicaria</i>	19
Reed canarygrass	<i>Phalaris arundinacea</i>	39
Rugosa rose	<i>Rosa rugosa</i>	Less than 1
Sheep sorrel	<i>Rumex acetosella</i>	76
Spotted knapweed	<i>Centaurea maculosa</i>	2
Winged burning bush	<i>Euonymus alatus</i>	Less than 1

Refuge staff released insects to serve as biological agents for purple loosestrife control from 1995 until about 2005 (table 3.14). The refuge used two types of insects in an attempt to reduce that amount of loosestrife on the refuge: *Galerucella* spp. beetles and *Hylobius transversovittatus* weevils. We have discontinued the biological control program given our poor success due to low beetle and weevil survival and the fact that purple loosestrife occurs in dispersed, low density populations on the refuge.

**Table 3.14. Biological Control of Purple Loosestrife on Great Bay Refuge, 1995 to 2003.**

Year	Number of <i>Galerucella</i> Beetles Released	Number of <i>Hylobius</i> Weevils Released
1995	2,000	1,000
1996	1,000	300
1997	2,000	0
1998	6,000	0
1999	5,000	0
2000	Unknown	500
2001	80	2,000
2002	Unknown	1,000
2003	400	0

## Fish and Wildlife

### Threatened and Endangered Species

Great Bay Estuary provides habitat for 23 species of State threatened or endangered plants and animals. The refuge hosts several State-listed species including upland sandpiper (endangered) and bald eagle, pied-billed grebe, and common tern (threatened). The State endangered upland sandpiper nests on the adjacent Pease International Tradeport and has recently appeared on the refuge during breeding season. Pied-billed grebes have been reported from Stubbs Pond. Historically, the bay provided habitat for small colonies of common terns, although they tended to experience low productivity. With the success of the tern colony at the Isles of Shoals, the bay's colonies have become less important in the overall picture, although the colony on Hen Island continues to support roughly a dozen pairs.

Osprey populations, a State species of special concern, have been increasing on the bay since the mid-1990s, and in 2006 there were nine known pairs. Not only does the bay host a significant and growing portion of the State's breeding osprey population, it also provides valuable habitat for osprey during spring and fall migration. Statewide, the population is doing well and was recently removed from the State's threatened list.

### Birds

The estuary is recognized as a New Hampshire Important Bird Area (IBA). The New Hampshire IBA program began in 2002 as a partnership among New Hampshire Audubon, NHFG, and UNH-Cooperative Extension. Since its inception, the New Hampshire program has identified 17 IBAs throughout the State. The Great Bay IBA was identified based on three criteria (NH Bird Records 2009):





Tim Williams

*Great blue heron*

1. The presence of threatened and endangered bird species.
2. The presence of other bird species and habitats of conservation concern.
3. The provision of areas where bird species congregate during breeding, migration, or overwintering.

As highlighted above, the Great Bay Estuary and refuge provide habitat for four State-listed bird species. Other bird species of conservation concern in the estuary include the American black duck, salt marsh and Nelson's sparrows, Virginia rail, and least bittern. Major habitats of conservation concern include estuarine habitat, salt marsh, mudflats, and emergent freshwater marsh.

Great Bay Estuary and adjacent habitats provide a major wintering and migration stopover for 20 species of waterfowl, 27 species of shorebirds, and 13 species of wading birds. Over 80 percent of all waterfowl that winter in New Hampshire coastal areas are found in Great Bay. Great Bay is the primary wintering area for black ducks in New Hampshire, with 1,000 to 2,000 ducks usually tallied on the Christmas Bird Count. In contrast, the rest of the State combined supports 500 to 1,000 black ducks. It is also an important wintering area for bald eagles, and a breeding area for osprey.

Although it supports much less salt marsh than the New Hampshire coast, the bay's marshes are home to most of the State's populations of Nelson's sparrow. Great Bay Refuge is at the southern edge of the sparrow's global range (<http://iba.audubon.org/iba/viewSiteProfile.do?siteId=2414&navSite=state>; accessed May 2011).

The bay is also one of the primary bald eagle wintering areas in New Hampshire. Eagles use large trees on the refuge, particularly living and dead white and red pines on Woodman Point and Thomas Point, as daytime perch sites or as occasional roost sites. In 2011, a pair of bald eagles nested on the refuge adjacent to the bay, and successfully fledged one chick. The oak-hickory forests and shrub habitats support other many breeding and migrating landbirds of conservation concern.

Breeding bird surveys were conducted intermittently from 1994 to 2008. Table 3.15 below summarizes some of the more common species during June surveys. The species are organized from highest to lowest average relative abundance. Grassland breeding bird surveys have also been conducted. Table 3.16 summarizes the relative abundance of grassland breeding bird species detected during surveys in refuge grasslands between 1999 and 2010. Again, the species are organized from highest to lowest average relative abundance. See appendix A for a complete list of bird species of concern on the refuge.

**Table 3.15. Relative Abundance\* of Birds Detected During Breeding Bird Surveys on Great Bay Refuge from June 1994 to 2007.**

<b>Species</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>2003</b>	<b>2006</b>	<b>2007</b>	<b>Average</b>
Red eyed vireo	1.50	1.08	1.24	1.00	0.74	1.22	0.64	1.02	1.05
American crow	1.54	1.10	0.74	0.82	0.48	0.20	0.58	0.72	0.77
Blue jay	1.02	0.83	0.52	0.63	0.60	0.78	0.94	0.86	0.77
Common yellowthroat	1.11	0.54	0.80	0.92	0.86	0.53	0.36	0.56	0.71
Black-capped chickadee	0.91	0.69	0.84	1.04	0.38	0.49	0.60	0.40	0.67
Ovenbird	0.78	0.46	0.68	0.53	0.54	0.45	0.76	0.88	0.64
Red-winged blackbird	0.43	0.54	0.40	0.49	0.36	0.59	0.86	1.08	0.60
American goldfinch	0.17	0.63	0.44	0.22	0.30	1.22	0.80	0.82	0.58
Tufted titmouse	0.52	0.52	0.28	0.45	0.32	0.24	0.52	0.40	0.41
Gray catbird	0.50	0.42	0.38	0.47	0.50	0.22	0.34	0.30	0.39
American robin	0.33	0.15	0.46	0.29	0.26	0.43	0.48	0.64	0.38
Eastern wood pewee	0.39	0.35	0.24	0.41	0.34	0.47	0.44	0.28	0.36
Scarlet tanager	0.17	0.52	0.50	0.31	0.26	0.39	0.40	0.34	0.36
Mourning dove	0.35	0.31	0.42	0.37	0.50	0.29	0.32	0.24	0.35
Baltimore oriole	0.26	0.31	0.40	0.24	0.26	0.27	0.40	0.42	0.32
Black and white warbler	0.19	0.39	0.40	0.34	0.28	0.30	0.30	0.34	0.32
Wood thrush	0.35	0.17	0.12	0.22	0.42	0.29	0.60	0.34	0.31
Great crested flycatcher	0.43	0.46	0.34	0.29	0.20	0.45	0.08	0.20	0.30
Song sparrow	0.43	0.27	0.16	0.29	0.28	0.39	0.30	0.26	0.30
Cedar waxwing	0.00	0.33	0.24	0.22	0.28	0.12	0.34	0.54	0.26
Pine warbler	0.33	0.31	0.20	0.29	0.24	0.20	0.24	0.28	0.26
Northern Cardinal	0.39	0.33	0.06	0.22	0.16	0.35	0.24	0.28	0.25
Brown-headed cowbird	0.22	0.38	0.38	0.33	0.08	0.08	0.28	0.16	0.24
European starling	0.11	0.29	0.28	0.16	0.28	0.14	0.22	0.22	0.21

Species	1994	1995	1996	1997	1998	2003	2006	2007	Average
Rose-breasted grosbeak	0.20	0.27	0.12	0.24	0.14	0.29	0.24	0.20	0.21
Black throated green warbler	0.39	0.29	0.24	0.27	0.18	0.10	0.06	0.00	0.19
Eastern kingbird	0.28	0.21	0.16	0.18	0.10	0.20	0.16	0.22	0.19
Eastern towhee	0.24	0.23	0.14	0.20	0.16	0.20	0.16	0.20	0.19
Bobolink	0.17	0.33	0.06	0.06	0.40	0.04	0.20	0.14	0.18
Common grackle	0.04	0.29	0.18	0.02	0.00	0.29	0.40	0.22	0.18
Field sparrow	0.17	0.21	0.12	0.31	0.28	0.18	0.06	0.10	0.18
Yellow warbler	0.24	0.13	0.24	0.24	0.16	0.12	0.08	0.20	0.18
Chestnut sided warbler	0.35	0.25	0.16	0.18	0.14	0.10	0.02	0.02	0.15
Downy woodpecker	0.22	0.17	0.08	0.10	0.32	0.06	0.22	0.06	0.15
Hairy woodpecker	0.04	0.17	0.06	0.12	0.14	0.10	0.22	0.26	0.14
Northern flicker	0.13	0.23	0.20	0.22	0.20	0.08	0.00	0.00	0.13
White-breasted nuthatch	0.00	0.13	0.04	0.14	0.14	0.16	0.26	0.06	0.12
Indigo bunting	0.04	0.08	0.14	0.14	0.04	0.04	0.16	0.14	0.10
Chimney swift	0.00	0.52	0.08	0.00	0.00	0.00	0.00	0.16	0.09
Eastern meadowlark	0.15	0.10	0.04	0.04	0.02	0.06	0.12	0.16	0.09
Eastern phoebe	0.20	0.19	0.08	0.10	0.02	0.02	0.02	0.08	0.09
House finch	0.17	0.33	0.12	0.04	0.04	0.00	0.04	0.00	0.09
Mallard	0.00	0.00	0.00	0.16	0.00	0.04	0.42	0.10	0.09
American black duck	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.60	0.08
American redstart	0.11	0.06	0.08	0.14	0.08	0.10	0.02	0.04	0.08
Killdeer	0.11	0.15	0.06	0.06	0.02	0.04	0.02	0.16	0.08
Barn swallow	0.00	0.13	0.10	0.04	0.00	0.06	0.02	0.18	0.07
Canada goose	0.00	0.00	0.00	0.00	0.00	0.08	0.06	0.42	0.07
Northern mockingbird	0.04	0.02	0.08	0.12	0.14	0.04	0.02	0.00	0.06

Species	1994	1995	1996	1997	1998	2003	2006	2007	Average
Chipping sparrow	0.07	0.00	0.10	0.04	0.02	0.02	0.06	0.10	0.05
Osprey	0.00	0.00	0.00	0.06	0.00	0.04	0.12	0.18	0.05
Tree swallow	0.00	0.10	0.14	0.02	0.02	0.10	0.02	0.00	0.05
Veery	0.07	0.06	0.06	0.02	0.08	0.02	0.00	0.08	0.05
Willow flycatcher	0.02	0.02	0.10	0.12	0.08	0.04	0.02	0.00	0.05
Wild turkey	0.00	0.00	0.00	0.00	0.02	0.02	0.04	0.20	0.04
Black-billed cuckoo	0.00	0.04	0.02	0.04	0.00	0.06	0.04	0.02	0.03
Brown creeper	0.04	0.02	0.04	0.08	0.04	0.00	0.02	0.00	0.03
Brown thrasher	0.07	0.06	0.02	0.02	0.00	0.00	0.04	0.02	0.03
Great blue heron	0.00	0.00	0.00	0.06	0.02	0.06	0.08	0.04	0.03
Prairie warbler	0.04	0.06	0.04	0.04	0.02	0.00	0.02	0.00	0.03
Warbling vireo	0.04	0.04	0.02	0.00	0.02	0.00	0.06	0.02	0.03

\* Relative abundance is the average number of birds per species detected per survey point per survey. Only species that are detected consistently from year to year are represented in the table.

**Table 3.16. Relative Abundance\* of Grassland Breeding Birds Detected During Surveys Conducted on Grassland Management Units from 1999 to 2010 on Great Bay Refuge.**

Species	Relative Abundance*						
	1999	2000	2001	2002	2003	2010	Average
Red-winged blackbird	0.50	1.64	1.50	2.42	1.91	2.43	1.72
Bobolink	0.06	1.68	0.89	1.46	0.87	0.00	1.01
Field sparrow	1.75	0.64	1.00	0.65	0.52	0.57	0.84
Eastern meadowlark	0.00	0.48	0.32	0.50	0.70	0.00	0.40
Upland sandpiper	0.00	0.04	0.11	0.00	0.04	0.00	0.04
American kestrel	0.00	0.04	0.04	0.08	0.00	0.00	0.03
Savannah sparrow	0.19	0.00	0.00	0.00	0.00	0.00	0.02
Vesper sparrow	0.00	0.00	0.04	0.00	0.00	0.00	0.01

\* Relative abundance is the average number of birds per species detected per survey point per survey.

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Lower Peverly Pond  
looking south

### Mammals

Numerous mammals also occur on the refuge. Common species include gray squirrel, shorttail shrew, Eastern cottontail, beaver, red fox, muskrat, and white-tailed deer. The size of the deer population is unknown as they can move freely on and off the refuge. A moose was seen and photographed on the refuge in June 2009. See appendix A for a complete list of mammal species of concern on the refuge.

At least six species of bats occur on the refuge. Great Bay Refuge is within the historical range of the federally endangered Indiana bat and supports suitable habitat; however, this species has no current

records from New Hampshire. From 2009 to 2011, the Service hired Biodiversity Research Institute (BRI) to survey for bats at Great Bay Refuge. BRI collected bat capture and echolocation data at the wetland on the Ferry Way Trail. Mist nets and Pettersson ultrasonic detection equipment were used to monitor bat activity in September 2009, July 2010, July 2011, and September 2011. BRI captured multiple bat species in mist nets on the refuge (table 3.17). Migratory species included northern myotis, eastern small-footed bat (State-listed endangered), and little brown bats. Breeding species (lactating females caught) included northern myotis, big brown bat, eastern small-footed bat, and red bat. (Yates and Meattay 2010). Acoustic monitoring also detected hoary bat during migration.

**Table 3.17. Bats Detected on Great Bay Refuge in 2009 and 2011.**

Common Name	September 2009	July 2010	July 2011	September 2011
	2 nights	3 nights	3 nights	2 nights
Big brown bat	0	10	7	0
Eastern red bat	0	3	1	2
Eastern small-footed bat	4	2	1	1
Hoary bat	0	0	0	0
Little brown bat	1	0	1	0
Northern myotis	10	19	19	9
Unidentified <i>Myotis</i> species	0	0	0	2

Conservation focus on bats have been increasing in the past few years due to high population declines for multiple bat species associated with white-nosed



syndrome. In June 2011, the Service completed a 90-day finding on the petition to list the northern myotis and the eastern small-footed bat (76 FR 38095). Their finding concluded that the petition to list these two species presented substantial scientific information indicating that the listing of these species may be warranted. A more detailed 12-month finding on whether or not the listing of these species is warranted is expected to be completed in June 2012. The refuge is also working with a diverse consortium of Federal, State, and academic bat experts and land managers to adapt old military bunkers in the refuge's former Weapons Storage Area to bat hibernacula (see goal 2, objective 2.3 in chapter 4 for more details).

### Fish

In the fall of 1992, the Service's Laconia Office of Fishery Assistance conducted a survey of the fish present in three ponds on the refuge. Surveys were conducted on Upper Peverly Pond, Lower Peverly Pond, and Stubbs Pond using an 18.0 foot (5.5 m) boom-type direct current electrofishing boat. This survey was repeated in 2007 (Brown 2008). Generally, the species composition and relative abundance remained consistent between surveys (table 3.18). The following exceptions were observed. A few chain pickerel and rainbow trout were observed in 1992, but not in 2007 in Upper Peverly Pond. American eel and sunfish were more abundant in 2007 than in 1992 in Lower Peverly Pond. American eel, sunfish, and yellow perch were more abundant in Stubbs Pond in 2007 than in 1992. As in 1992, the greatest species diversity was encountered in Stubbs Pond. In 2007, Stubbs was the only pond where chain pickerel, brown bullhead, and golden shiner were captured. Golden shiners were captured in only two small areas in the pond. In all three ponds, there has been a shift toward a greater proportion of larger quality sized largemouth bass in 2007 relative to 1992 (USFWS 1994, 2010). See appendix A for a complete list of fish species of concern on the refuge.

**Table 3.18. Fish Species Composition and Abundance in Upper Peverly, Lower Peverly, and Stubbs Ponds in 1992 and 2007.**

Species	Upper Peverly Pond		Lower Peverly Pond		Stubbs Pond	
	1992 Survey	2007 Survey	1992 Survey	2007 Survey	1992 Survey	2007 Survey
American eel	F	F	F	M	F	A
Largemouth bass	A	A	A	A	A	A
Sunfish	A	A	F	A	M	A
Alewife	N	N	N	N	N	N
Golden Shiner	N	N	N	N	F	F
Mummichog	N	N	N	N	N	N
Banded Killifish	N	N	N	N	N	N
Chain Pickerel	F	N	N	N	F	F
Brown Bullhead	N	N	N	N	F	F
Yellow Perch	N	N	F	F	M	A
Rainbow Trout	F	N	N	N	N	N
Brook Trout	N	N	N	N	N	N

*Note: A = abundant, M = moderate, F = few, N = none*

### Amphibians and Reptiles

Several surveys and studies have officially documented 15 species of reptiles and amphibians on Great Bay Refuge (table 3.19). Appendix A lists the reptile and amphibian species of concern known, or likely, to occur on the refuge and the Karner blue butterfly conservation easement.

**Table 3.19. Amphibians and Reptiles Documented on Great Bay Refuge.**

Species	Sighting	Sources*
<b>Frogs and Toads</b>		
American toad	calling, observed	Suomala 1995, 1996; Taylor 1994
Bullfrog	observed	Taylor 1994
Gray tree frog	observed	Taylor 1994
Green frog	observed	Suomala 1995, 1996; Taylor 1994
Leopard frog	observed	Suomala 1995, 1996
Pickerel frog	observed	Taylor 1994
Spring peeper	calling	Suomala 1995, 1996; Taylor 1994
Wood frog	calling, observed	Suomala 1995, 1996; Taylor 1994
<b>Salamanders</b>		
Red-backed salamander	observed	Taylor 1994
<b>Turtles</b>		
Painted turtle	observed, nest found	Suomala 1995, 1996; Taylor 1994
Snapping turtle	observed	Suomala 1995, 1996; Taylor 1994
<b>Snakes</b>		
Common garter snake	observed	Kjoss 1999; Taylor 1994
Northern brown snake	observed	Kjoss 1999
Northern red-bellied snake	observed	Kjoss 1999
Smooth green snake	observed	Kjoss 1999

\*Kjoss, V. A. 1999. *UNH Masters of Science research study.*

\*Suomala, R. *Reptiles and amphibians recorded at Great Bay Refuge, 1995 and 1996.*

\*Taylor, J. *Checklist of amphibians and reptiles for Great Bay Refuge, June 15, 1994.*

### Forest Health, Including Forest Pests

The U.S. Forest Service's Durham Field Office assessed the health of Great Bay Refuge's forests in 2006 (Dodds and Cooke 2006). We plan to use the results of their assessment to guide our forest management decisions and address any potential health concerns for the refuge's forests. During their assessment, they first mapped over 61 forested stands on the refuge, which included 10 different

natural community types. They then inventoried and collected the following information in 18 of these stands:

- A general overview of the conditions of forested areas.
- The “health” of overstory trees (e.g., crown condition, growth form, etc.).
- The amount of regeneration occurring in stands.
- The presence/absence of native insects at damaging levels.
- The presence of exotic or invasive species that could threaten the integrity of native ecosystems.

The only potential health concern the assessment found was that many of the forested stands on the refuge are “overstocked.” Overall, they found that Great Bay Refuge has a very diverse range of forested habitat given its relatively small size. The refuge also has numerous cavities in both living and dead hardwoods and conifers. These cavities provide important nesting, roosting, and denning sites for wildlife species including birds, mammals, reptiles, and amphibians. They also conducted visual surveys for nonnative insects on inventory plots and on transects through the stands. Although they found no nonnative insects during their 2006 survey, in 2010, the hemlock woolly adelgid was found along McIntyre Road. We will continue to monitor for nonnative insect pests, particularly Asian long-horned beetle, emerald ash borer, and *Sirex noctilio*, which have been found in the Northeast and have caused serious economic and ecological impacts.

The Forest Service also conducts annual aerial surveys to assess forest health condition. In 2007, they mapped 5 acres of tree damage on the refuge, likely related to ice storms. Their 2008 survey detected no damage on the refuge. Their 2009 survey documented discoloration, dieback, and branch breakage on 5 acres of pine plantation located west of the refuge entrance on Merrimack Drive. However, in 2010, the refuge biologist and Dan Sperduto of NHB visited this pine plantation site and found no evidence of a pathogen on the trees. While the native oak-hickory species were germinating in the understory, only the planted Scots pine showed signs of dieback.

### **Invasive Animals**

The mute swan is a Eurasian species that is not native to North America. It was introduced to the U.S. in the late 1800s as a decorative waterfowl for parks, zoos, and private estates. By the early 1900s, small numbers of birds had escaped into the wild, began nesting, and soon established feral populations. Currently, mute swan populations are well established in many states, mainly along the North Atlantic Coast. Populations in the Atlantic Flyway have grown dramatically, from less than 1,000 in the mid-1950s, to more than 14,000 in 2002. Mute swans are highly invasive in wetland habitats, impact native species of fish and wildlife, damage commercial agricultural crops, and pose a threat to human health and safety. Because they consume large quantities of submerged aquatic vegetation and are aggressive, mute swans compete directly with many other waterbird and fish species for critical habitats. Mute swans are highly territorial, and will often vigorously defend nest and brood sites from intrusion by other wildlife, causing serious harm. Some have also attacked humans (Atlantic Flyway Council 2003). The Service continues to work with the NHFG to control this nonnative species within Great Bay Estuary.

### **Environmental Contaminants**

Since Great Bay Refuge is part of the former Pease Air Force Base, the Air Force continues to conduct long-term monitoring of groundwater, surface water, sediment, and fish tissue on the refuge. The original Air Force Base landfill,

operated from 1953 to 1961, is within the boundaries of the refuge lying east of Upper Peverly Pond. According to Air Force Base records, the types of material dumped in this landfill include construction debris, domestic solid waste, and shop waste. The Peverly Brook drainage system receives surface water and sediment from the former landfill, the former Weapons Storage Area, and other dump sites. The primary contaminants from these discharge areas are metals (e.g., aluminum, arsenic, iron, lead, manganese, nickel, and zinc), and pesticides (e.g., DDT-related compounds and lindane) (Department of the Air Force 2001). The levels of DDT in the sediments of the Peverly Brook drainage system, especially Stubbs Pond, may pose a risk to fish. The Air Force believes that it may be safer to leave the contaminated sediments in place, rather than risk re-suspending them in the water while trying to remove them. Currently, the Air Force and the EPA disagree on the need for continued fish sampling (Memorandum from the Air Force to EPA and NH DES dated April 11, 2003). The Pease International Tradeport also continues use urea as a de-icing agent, which may cause elevated levels of nutrients in refuge ponds and the Peverly Brook system (<http://ecos.fws.gov/cap/>; accessed May 2011). Appendix I is a retrospective review of sampling plans and data relating to the clean-up of the Peverly Brook drainage by the Air Force.

Mercury in the blood collected from osprey chicks on the refuge in 2000 was elevated, as compared to other osprey from New England. This is part of a larger trend of elevated mercury levels in wildlife in southeastern New Hampshire, considered a “hotspot” due to prevailing weather patterns (<http://ecos.fws.gov/cap/>; accessed May 2011).

The Service’s Northeast Region has conducted studies to determine the extent and magnitude of the “abnormal frog” phenomenon on national wildlife refuges since 1987. At Great Bay Refuge, a team of regional biologists collected data from 1997 to 2005 to assess the level of birth defects in frogs on the refuge. The team compiled their findings in the May 2006 report titled, “Investigation of Contaminant Effects on Frog Development at Great Bay National Wildlife Refuge, Newington, New Hampshire” (Pinkney et al. 2006). Overall, the study found that only a relatively small percentage of frogs on the refuge had birth defects (2 out of 207 wood frogs sampled, or 2.4 percent). However, they did find high rates of mortality for wood frogs in Stubbs Pond, and extended larval periods and high rates (63 percent) of rounded femurs, which can impair hopping ability, in wood frogs in Beaver Pond. Although it appeared that there was some effect of water and sediment contamination on frogs on the refuge, it was not possible to link the observed abnormalities to any specific chemicals. The report is available, upon request, from the Parker River Refuge headquarters.

## Cultural and Historic Resources

### Historic Structures

The refuge includes three areas that contain historic, or potentially historic, structures:

- The Margeson Estate.
- The 1950s-era Weapon Storage Area.
- The Fabyan Point cabins.

The Margeson Estate is located on Woodman Point in a section of the refuge that is closed to the public. The estate’s main house (1894) and caretaker’s cottage (circa 1920s) are listed on the National Register of Historic Places (National Register). Since the refuge’s establishment in 1992, the main house has remained unoccupied. In 1994 through 1995, a new roof was installed on the main house. It was also tested for hazardous materials (e.g., asbestos and lead paint) in 1994 and

1998. From 1992 to 2002, the refuge used the caretaker's cottage for housing. In 1994 through 1995, the cottage's exterior was painted and new roof was installed. In 1998, it was tested for lead paint and in 1999, the window sashes on its first story were replaced.

The Margeson Estate's main house is in poor condition due to deterioration that has taken place over at least the past three decades, with extensive moisture damage to the structure and finishes that occurred prior to the roof replacement. There is also pervasive mold throughout the building. The caretaker's cottage is in good condition, but also has pervasive mold. Both buildings are uninhabitable in their current condition. The refuge does not have a potential use for either building.

The former Weapons Storage Area is located east of the existing refuge visitor headquarters. It is surrounded by a fence and is also closed to the public. The area was used by the Air Force as a highly secure site for storing and maintaining various types of munitions (e.g., small arms ammunition) and weapons systems (e.g., conventional and nonconventional missiles and bombs). In developing the area, the Air Force heavily manipulated the site. They constructed drainage ditches throughout the area to try to improve drainage around their structures. Based on 1952 aerial photos, it does not appear that natural wetlands were present on the site prior to their construction of the Weapons Storage Area. When it was in use, the area covered 50 acres and was surrounded by an 8-foot high chain link fencing topped with barbed wire.

*Former Weapons Storage Area*



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Facilities within the area included 15 earth-covered storage bunkers and various nondescript one-story concrete-block storage, support, and administrative buildings. The barrel-vaulted bunkers are made from reinforced concrete and are covered with about 2 feet of soil and vegetation. Two of the bunkers were built for storage of capsules for early nuclear weapon designs. Each bunker has several ventilation holes and two, large steel doors at the front.

Since acquiring the refuge in 1992, we have removed five buildings, the razor wire off the perimeter fence, and over 100 telephone and light poles from the Weapons Storage Area. We have also been removing and recycling metal from the bunkers and other buildings. We had asbestos removed from the concrete block

buildings between 2008 and 2009, which structurally altered the buildings. Our intent is to remove the remaining concrete block structures, water tower, and adjacent roads and fencing, as resources allow. As structures are removed, we will restore the disturbed areas to native habitat. Currently, we are using some of the bunkers for storage. We are also evaluating the potential to use some of the bunkers as hibernacula for roosting bats. We do not anticipate removing the bunkers because of the high estimated cost for their removal, their usefulness as storage spaces, and their potential as bat roosting habitat.



The third area that contains potentially historic structures is Fabyan Point, a peninsula at the end of Fabyan Point Road in a section of the refuge that is closed to the public. Fabyan Point has a complex of six small cabins along the Great Bay shoreline. Two cabins appear to date to the 1920s (one wood-framed and one concrete block), while the remaining four cabins date to circa 1947 (all wood-framed). Prior to the refuge's acquisition of Fabyan Point in 2003, the area was private property. By this time, the five wood-framed cabins were in poor condition. They are supported by concrete block piers that rest directly on the ground and which have heaved over the years, affecting the structure of the buildings. The buildings also suffer from pervasive mold and moisture damage. The concrete block cabin is in good condition, but also has pervasive mold. None of the buildings are inhabitable and the refuge does not have a potential use for any of the buildings. The cabins have also become a target of vandals and squatters.

### **Archaeological Resources**

In December 1988, the Pease Air Force Base was selected as one of the 86 military installations to be closed as part of the Secretary of Defense's Commission on Base Realignment and Closure (BRAC). Archaeological resources in the refuge are mostly known from two 1991 surveys done as part of the BRAC process and from a 1999 to 2000 study undertaken for the town of Newington and funded by a certified local government planning grant. Results of both have recently been incorporated into an archaeological overview produced as part of the CCP process (Public Archaeology Laboratory, Inc. 2010).

Only one pre-Contact archaeological site has been identified on the refuge. However, in light of proximity to maritime resources of the bay, as well as freshwater and upland resources, other unrecorded sites of that period are very likely to be present. Fifteen Euro-American sites are recorded within the refuge. Those include the landing for a 17th century ferry to Durham, a 19th century brickyard, and a number of late 17th to 20th century farmsteads. Burials in four small cemeteries were exhumed and reburied off-refuge when the Air Force Base was constructed. It is possible that some unmarked graves were not discovered and removed. None of the cemetery locations have surface evidence today. While it is likely that all sites dating from the 18th century and later within the refuge have been identified, it is possible that additional 17th century sites exist, as those tend to be less visible on both the landscape and historic period maps. The city of Portsmouth purchased land and water rights to Peverly Brook and its tributary streams in 1900. The brook was dammed in two places and by 1903 water was being pumped to the city's public water supply. That water system was discontinued when the Air Force acquired the lands in the 1940s (Rowe 1987). The Weapons Storage Area and a considerable area in the northeast part of the refuge were both heavily disturbed by airbase construction. In 1962, the Air Force constructed Stubbs Pond impoundment. Most of the remaining refuge land was unaffected by airbase construction and use.

### **Public Use Programs**

As an unstaffed refuge, Great Bay Refuge has had limited ability to conduct a visitor services program. Despite these limitations, the refuge is popular, especially for birders and walkers. The estimated annual visitation is approximately 30,000 visitors.

The Peverly Pond Trail (described below) is wheelchair accessible, as are the restrooms and refuge headquarters. The refuge is open from dawn to dusk, with vehicle access controlled by a timed gate along Arboretum Drive. The trails are for foot traffic only. Bicycles and motor vehicles are limited to the entrance road and parking lot. Pets are not permitted on the refuge. All other areas beyond the parking lot and the two trails are closed to the public.

## Trails

Two nature trails are accessible from the visitor parking lot at the end of Merrimack Drive, adjacent to the refuge headquarters building (map 3.2).

### Ferry Way Trail

The 2-mile Ferry Way Trail begins at the northwestern edge of the parking lot. It starts out as an asphalt path next to a chain link fence along the former Weapons Storage Area. After following the fence line, the trail crosses a woods road and swings left onto another old woods road. The trail passes through woods and fields, by wetlands and an apple orchard, loops down to Great Bay, then backtracks to the parking lot. A leisurely walk on this moderately difficult trail takes about 2 hours.

### Peverly Pond Trail

The 0.5-mile Peverly Pond Trail begins to the east of the parking lot. This loop trail winds through an oak-pine forest, follows a portion of shoreline along Upper Peverly Pond, and passes several vernal pools. A photography blind is located along the trail and offers views of Upper Peverly Pond. A leisurely walk on this easy trail takes about 30 minutes. The trail is fully accessible.

## Fishing

Various military activities on the former Pease Air Force Base resulted in, or contributed to, contamination of sediments, water, and fish on what are now refuge lands. Over the last 10 to 15 years, studies and monitoring shows that while some contaminant issues are improving, other concerns still exist. In particular, we are concerned about contamination in the Peverly Brook drainage and the refuge's three impoundments. We are currently uncertain about the impact of this contamination on fish health and water quality, and the risks to humans from handling or consumption. Due to these concerns, the refuge is closed to fishing.

## Hunting

### History

Prior to Service ownership, deer and waterfowl hunting were permitted by the Air Force, but it was limited to military personnel, retirees, and dependents, and only in certain areas. From 1967 to 1989, the Air Force used hunting as a management tool, due to the need to minimize aircraft strikes on the runway. It was estimated that 8 to 10 deer were taken annually from throughout the former Pease Air Force Base. The Air Force also permitted waterfowl hunting only on Stubbs Pond and only for Air Force personnel, dependents, and retirees. The former base was closed to hunting from 1989 to 1993 in advance of the land transfer to the Service (USFWS 1995). Currently, the only types of hunting allowed on the refuge are white-tailed deer and waterfowl hunting are permitted on the refuge, as stipulated in 50 CFR, Part 32, Subsection B, § 32.48.

### White-tailed Deer Hunting

When the refuge was first proposed, the Service received a range of public comments on deer hunting. Some thought the hunt should continue, while others thought hunting should only occur as a biological management tool. A Hunt Plan was completed for Great Bay Refuge in 1993 (USFWS 1993). In 1995 the Service completed an EA for establishing and conducting an annual, public white-tailed deer hunting program and waterfowl hunting program on the refuge. The determination from this assessment was to open the refuge to controlled hunting of white-tailed deer and waterfowl in accordance with all Federal, State, and local regulations (USFWS 1995).

The first white-tailed deer hunt on the refuge occurred in the fall of 1996 and has been held every year since then. The hunt is a 2-day, Saturday to Sunday hunt, by permit only. A maximum of 20 permits per day are drawn from a pool of applicants each year. From 1996 to 2007 the number of hunters has ranged from

13 to 22. The number of deer harvested during a given hunt has ranged from 8 to 22 deer, with a mix of does and bucks taken.

#### **Waterfowl Hunting**

The 1995 hunting EA also provided for a waterfowl hunt program on the refuge. Waterfowl hunting is currently allowed along the shoreline of the refuge up to posted refuge boundary signs. Waterfowl hunters are only allowed access to the refuge by boats launched from off-refuge locations; overland access through the refuge is prohibited. The 1995 EA allowed for additional restrictions if needed, including limiting the number of waterfowl hunters. Currently, the number of waterfowl hunters at the refuge is so low (less than 3 people per season), restrictions on numbers of hunters have not been necessary. Other sites around Great Bay provide more extensive waterfowl hunting opportunities and see more use.

### **Volunteer Program**

Volunteers are particularly vital at Great Bay Refuge, given the lack of Service staff. The Wednesday Volunteer Group is the biggest group on the refuge that works most of the year except winters. Their projects are many and varied. They have been salvaging scrap metal to be recycled from the Fabyan Point cabins and former military buildings on the refuge. They also maintain trails, mow grassland habitat, assist with waterfowl banding, maintain and repair equipment, monitor the fish ladder and fish activity, tend the native garden outside of the headquarters, conduct invasive species inventories and control, and conduct osprey surveys. For the past three summers, a volunteer couple has been living and working on the refuge. They have helped tend the gardens, perform light maintenance, and provide other assistance as needed. The Service has also engaged volunteers through other programs, such as Phillips-Exeter Academy classes. Volunteers contribute approximately 2,500 to 3,000 hours on the refuge each year. The refuge does not currently have an active Friends Group.

### **Key Refuge Partnerships**

#### **Great Bay Resource Protection Partnership**

The GBRPP is a coalition of public and private conservation groups that formed in 1994 to help protect the remaining critical habitats within and around Great Bay. The GBRPP takes a comprehensive, landscape-scale approach to conservation and habitat protection by developing and implementing conservation strategies through a combination of scientific field studies and ongoing communication with local, regional, State, and national conservation representatives. So far, the partnership has been very successful in their land protection efforts.

The Partnership's primary activities include the following:

- **Conservation Planning:** The Partnership conducts habitat analysis studies to identify significant habitat areas to be considered for protection.
- **Land Conservation:** Based on the conservation planning field work, the Partnership seeks to protect large blocks of significant conservation land through working voluntarily with landowners on the purchase or donation of land or conservation easements.
- **Stewardship:** Partner organizations collaborate on stewardship activities such as restoration, resource management, and public access on protected lands.
- **Education and Outreach:** Partner representatives provide technical assistance to communities, conservation entities, and landowners.

The principle partners, which meet quarterly in the GBRPP, are Ducks Unlimited, Inc., GBNERR, New Hampshire Audubon Society, NHFG, SPNHF,

TNC–New Hampshire Chapter (lead partner), the EPA, the Service, the refuge, and the USDA–Natural Resources Conservation Service. The partnership works closely with several regional land trusts and conservation districts including the Southeast Land Trust of New Hampshire, Bear Paw Regional Greenways, Rockingham County Conservation District, Strafford Rivers Conservancy, and Strafford County Conservation District (<http://www.greatbaypartnership.org/>; accessed May 2011).

#### **New Hampshire Coastal Watershed Invasive Plant Partnership**

Great Bay Refuge, represented by the refuge manager, is a “Sustaining Partner” of the New Hampshire Coastal Watershed Invasive Plant Partnership (CWIPP). This partnership among 11 agencies and organizations concerned with invasive species was formed in 2008. The principal partners signed an agreement and created a framework of cooperation to address the effects of noxious and invasive plants across jurisdictional boundaries. The signatories agreed that it was to their mutual benefit and in their mutual interest to work cooperatively to inventory, monitor, control, and prevent the spread of invasive plants across jurisdictional boundaries within New Hampshire’s coastal watershed. The goal through this cooperative effort is to achieve better management of invasive plants while improving working relationships between the signatories and the public. Although sustaining partners are not signatories to the agreement, they, including Great Bay Refuge, have significant interests in the success of the partnership (<http://des.nh.gov/organization/divisions/water/wmb/coastal/cwipp/index.htm>; accessed May 2011).

#### **Law Enforcement**

Great Bay Refuge is situated at the end of a long dead-end road. The entrance is controlled by a timed gate that opens at dawn and closes at dusk. The lack of refuge staff stationed at Great Bay Refuge and the refuge’s relatively isolated location creates some law enforcement concerns. A refuge law enforcement officer is based out of the Parker River Refuge office, and serves both Great Bay and Wapack Refuges. In addition, a refuge law enforcement zone officer for this region is located at Mississquoi Refuge in northwestern Vermont. Given the shortage of law enforcement capacity, Great Bay Refuge maintains a critical partnership with the town of Newington Police Department.

#### **Pease Development Authority Wildlife/Bird Air Strike Hazard Committee**

In 1992 a Memorandum of Agreement (MOA) was signed between the Service, the Federal Aviation Administration (FAA), the U.S. Department of Agriculture–Animal and Plant Health Inspection Service, and PDA. The MOA calls for coordination and quarterly meetings among the parties. Meetings are designed to review and discuss past and future wildlife management practices by the Service and PDA on the refuge and the airport facility, respectively, discuss the effects of such management practices on airport operations and on Service trust resources, and discuss airport facility aircraft operations and their potential effects on the refuge (MOA 1992). The group of representatives is referred to as the Wildlife/Bird Air Strike Hazard Committee.

### **Karner Blue Butterfly Conservation Easement**

Great Bay Refuge also includes a 29-acre conservation easement, comprised of pine barrens habitat, in Concord, New Hampshire (map 1.2). The property is managed primarily for the federally endangered Karner blue butterfly. The conservation easement is approximately 45 miles west of Great Bay Refuge. The parcel abuts the Concord Airport and is within a fragmented, but important complex of remnant pine barrens habitat that supports rare moths and butterflies. The conservation easement land is a mix of open pitch pine-scrub oak, pine-hardwood, and other scrubland. Although not the focus of our management, the conservation easement’s habitat also supports several State-listed species and State species of concern, including hognose snake, black racer, and grasshopper



*Karner blue butterfly displaying upperside (right) and underside (far right) coloring*



sparrow. Additionally, table A.2 in appendix A list all of the species in greatest need of conservation that are potentially present on the conservation easement and throughout the Concord Pine Barrens.

This conservation easement was established in July 1992 through a cooperative agreement between the Service, the city of Concord, the CCDC, the U.S. Postal Service, and TNC. The conservation easement lies in the Concord Airport Industrial Park and consists of two adjacent parcels on which easements were donated to the Service by the city of Concord following an exchange of airport land between the city of Concord and the non-profit CCDC. TNC agreed to serve as a managing partner with the Service while the city of Concord and CCDC agreed to cooperate in the research and management of Karner butterfly habitat in management agreement areas.

Since 2008, Great Bay Refuge and the conservation easement have been administered by Parker River Refuge staff based in Newburyport, Massachusetts. There are no refuge buildings on the conservation easement and the property is closed to hunting. There is an unpaved right-of-way road, oriented east-west, that bisects the conservation easement. There are gates at the entrance and the exit of the property to preclude vehicle access. This unpaved road serves as an approximately 0.4-mile wildlife observation trail and is open to pedestrian access only. An informational kiosk located at the west entrance explains management for Karner blue butterflies.

From 1992 to 1999, TNC carried out most of the management on the conservation easement, which included removal of unwanted vegetation by mechanical methods and planting of wild lupine. In 1999, the Service conducted vegetation removal and a prescribed burn.

Since 2000, NHFG has conducted the onsite management which has continued with vegetation removal, herbicide applications, prescribed burning, plantings, moth and butterfly surveys, and a captive rearing program. NHFG received funding for some of their management activities on the conservation easement through a MOA with the New Hampshire Army National Guard (National Guard). This MOA, which was active through 2011, facilitated the transfer of funds from National Guard to NHFG support habitat restoration and monitoring activities, including prescribed burning, mowing, and forestry operations, in addition to mark-recapture surveys on the Karner blue butterfly and frosted elfin butterfly, vegetation plots, lupine populations, and presence or absence of other Lepidoptera. These funds were provided as mitigation for a helicopter hanger the National Guard built in an area identified as habitat for the federally endangered Karner blue butterfly.



Table 3.20 presents a brief outline of NHFG's habitat management on the conservation easement from 2000 to 2011. Table 3.20 includes the results of the captive rearing program and population monitoring data.

**Table 3.20. New Hampshire Fish and Game Management Activities at the Concord Pine Barrens from 2000 to 2011.**

Management Action	Total
Prescribed Burning	6 acres
Vegetation Removal	10 acres
Herbicide	3 acres
Planting of Seedlings	over 5, 500 seedlings
Planting of Seeds	over 6, 000 grams of seed

**Table 3.21. Captive Rearing of Karner Blue Butterflies for Release onto the Service's Concord Pine Barrens Conservation Easement.**

Year	Brood	Number of Adults <sup>1</sup>	Number of Wild Adults Marked <sup>2</sup>	Number of Adults Recaptured <sup>3</sup>
2000	1	0	—	—
2000	2	0	—	—
2001	1	44	—	—
2001	2	5	—	—
2002	1	193	—	—
2002	2	102	—	—
2003	1	203	—	—
2003	2	176	—	—
2004	1	337	—	—
2004	2	1,231	31	167
2005	1	607	39	160
2005	2	1,177	149	347
2006	1	1,138	21	149
2006	2	348	49	45
2007	1	505	20	49
2007	2	968	54	301
2008	1	271	58	65
2008	2	2,136	64	404
2009	1	1,017	87	316
2009	2	3,798	260	1,006

Year	Brood	Number of Adults <sup>1</sup>	Number of Wild Adults Marked <sup>2</sup>	Number of Adults Recaptured <sup>3</sup>
2010	1	194	320	245
2010	2	2,609	278	394
2011	1	22	58	29
2011	2	742	90	283

<sup>1</sup>Total adults enclosed in captive rearing laboratory for either breeding or release in New Hampshire and New York.

<sup>2</sup>Number of unmarked adult butterflies observed during mark recapture surveys.

<sup>3</sup>Number of marked adults observed during mark recapture surveys, including adults released from captive rearing laboratory.

### Additional Partnerships

There are several other crucial ongoing partnerships related to the conservation easement and its management.

#### Concord Municipal Airport Development and Conservation Management Agreement.

Participants in this agreement include the city of Concord, NHFG, the Service, New Hampshire Department of Resources and Economic Development, National Guard, and New Hampshire Department of Transportation–Division of Aeronautics. This agreement was executed in November 2000 for the purpose of managing airport lands adjacent to the Service conservation easement in a manner that provides and enhances essential habitat for federally listed and State-listed threatened and endangered butterfly and moth species, such as the Karner blue butterfly. The agreement serves as the city’s compensation to offset the loss of species and habitat in the designated development zones.

#### Kids for Karners

This program was started by the National Wildlife Federation and NHFG around 2000. Over the past 11 years, over 2,500 lupine and nectar plants have been grown by local school children and planted on the Service’s conservation easement land. The project includes a teachers training in the winter, classroom plantings in the spring, and a field trip to the conservation easement at the end of the school year to plant lupine and tour the Concord Pine Barrens.

## Chapter 4

Duane Raver/USFWS



*Alewife*

# Management Direction and Implementation

- Introduction
- Great Bay Refuge Management
- General Refuge Management
- Goals, Objectives, and Strategies

## Introduction

This chapter begins with a description of the process we used to formulate the management direction and implementation for Great Bay Refuge and the Karner blue butterfly conservation easement. We then present those actions that are required by law or regulation, have been previously approved, or that help to achieve multiple refuge goals. We also identify decisions we are not making at this time and that will require additional NEPA analysis before a final decision can be made. We conclude with details on our goals, objectives, and strategies for managing the refuge. The array of management actions described are those that, in our professional judgment, will best achieve the refuge's purposes, vision, goals, and best respond to public issues. Goals 1 through 4 apply to Great Bay Refuge management, while goal 5 applies to the Karner blue butterfly conservation easement.

Refuge goals are intentionally broad, descriptive statements of the desired future condition of refuge resources. By design, they are less quantitative, and more prescriptive, in defining the targets of our management. They also articulate the principal elements of refuge purposes and our vision statement, and provide a foundation for developing specific management objectives and strategies. As noted in chapter 1, developing a strategic plan to achieve refuge goals is the purpose for developing the CCP.

Objectives are essentially incremental steps toward achieving a goal and define the management targets in measurable terms. They provide the basis for determining more detailed strategies, monitoring refuge accomplishments, and evaluating our success. The Service guidance in "Writing Refuge Management Goals and Objectives: A Handbook" (USFWS 2004) recommends that objectives meet five criteria to be "SMART":

1. Specific
2. Measurable
3. Achievable
4. Results-oriented
5. Time-fixed

A rationale accompanies each objective to explain its context and why we think it is important. We will use the objectives to write refuge step-down plans, which we describe later in this chapter. We will measure our successes by how well we achieve those objectives.

The strategies for each objective are the specific or combined actions, tools, and techniques we may use to achieve an objective. The list of strategies under each objective represents the potential suite of actions that we may implement. We will further evaluate most of the strategies in refuge step-down plans, such as the HMP and Visitor Services Plan, as to how, when, and where they should be implemented.

For most objectives we also identified monitoring components. Monitoring will help us measure our success toward meeting the objectives.

## Overview of Great Bay Refuge Management

It is important to reemphasize that CCPs provide long-term guidance for management decisions through goals, objectives, and strategies. They represent our best estimate of future needs. This CCP details program levels and activities that are substantially above current budget allocations and, as such, should be viewed as strategic in nature. Our budgets are determined annually by Congress, and distributed through our Washington and Regional Offices, before arriving at field stations. In summary, the actions proposed in this CCP represent our strategic vision for the future. Final CCPs do not constitute a Service commitment for staffing increases, or funding for operations, maintenance, or future land acquisition. Implementation must be adjusted annually given the reality of budgets, staffing, and unforeseen critical priorities.

Our highest priority is the management of specific refuge habitats to support focal species whose habitat needs benefit other species of conservation concern that are found around Great Bay and in the larger landscape of coastal New Hampshire. In particular, we emphasize habitat for priority birds identified in BCR 30 such as migratory waterfowl, waterbirds, forest-dependent songbirds, shrubland species, and estuarine species of concern including oysters and eelgrass that are indicators of ecosystem health.



Woodman Point

Along the Peverly Brook stream, we plan to conduct activities to enhance water quality, improve habitat for migratory fish, and maintain habitat for waterfowl, marsh birds, and other aquatic species. Specifically, we will remove the Lower Peverly Pond Dam to create stream habitat, while maintaining the dams at Upper Peverly Pond and Stubbs

Pond to benefit a range of fish and wildlife. We believe that this combination of maintaining the largest freshwater impoundments and restoring a stretch of stream habitat enhances our contribution to protecting the diversity resources of concern in the Great Bay Estuary. In addition, the plan addresses ongoing concerns of contaminant levels in the sediments within Upper Peverly Pond caused by previous land uses. We will expand our conservation, research, and management partnerships to help restore and conserve the Great Bay estuarine ecosystem and to address emerging issues, including climate change and landscape-scale conservation.

Under this plan, we will manage approximately half of the former Weapons Storage Area as shrubland as a possible location for establishing a captive breeding program for New England cottontail, a Federal candidate species. We will manage the other half as grassland to provide nesting habitat for upland sandpipers and other grassland species of conservation concern. We will also evaluate the underground bunkers for their potential as bat hibernacula.

We will enhance our visitor services programs, which have been limited under current management due to lack of staff. For example, we will enhance the entrance to the refuge, create new interpretive materials, expand on an existing quality volunteer program, offer visitors more opportunities to learn about the refuge and the surrounding environs, and evaluate an expansion of hunting opportunities to include wild turkey and a fall bow deer season. These expanded programs will be possible through the proposed increased staffing and new refuge headquarters/visitor contact facility.

On the Karner blue butterfly conservation easement, we will enhance our partnership with NHFG to manage habitat in support of recovery of this species. In particular, we will continue to support the captive-rearing program and management of pine barrens habitat. We will also enhance interpretive opportunities by installing new interpretive signs, offering guided interpretive walks, and enhancing our Web-based information.

The habitat types that will result on the refuge under this plan are depicted on map 4.1. Maps 4.2 and 4.3 show refuge infrastructure and facilities, including those that will support the refuge's public use program. Map 4.4 shows how we will manage the Karner blue butterfly conservation easement under this plan.



Map 4.1. Planned Habitat Management for Great Bay National Wildlife Refuge



Map 4.2. Existing and Planned Public Use at Great Bay National Wildlife Refuge





Map 4.3. Public Use Facilities and Refuge Infrastructure at Great Bay National Wildlife Refuge



Map 4.4. Existing and Planned Trails at Karner Blue Butterfly Conservation Easement





## General Refuge Management

There are some actions we propose to take in managing Great Bay Refuge over the next 15 years that are required by law or policy, or represent actions that have undergone previous NEPA analysis, public review, agency review, and approval. Others may be administrative actions that do not necessarily require public review, but we want to highlight in this public document. They may also be actions we believe are critical to achieving the refuge's purpose, vision, and apply to multiple refuge goals.

All of the following actions, which we discuss in more detail below, are current practices or policies that will continue:

- Using an adaptive management approach, where appropriate.
- Reducing impacts from climate change.
- Developing refuge step-down plans.
- Providing refuge staffing, facilities, and administration.
- Protecting the rocky shore.
- Recognizing special designations.
- Managing invasive species.
- Protecting cultural resources.
- Distributing refuge revenue sharing payments.
- Findings of appropriateness and compatibility determinations.
- Issuing special use permits.
- Conducting additional NEPA analysis when required.
- Consulting with other Federal and State agencies.
- Evaluating land protection focus areas.

## Adaptive Management

We will employ an adaptive management approach for improving resource management by better understanding ecological systems through iterative learning. In 2007, Secretary of Interior Dirk Kempthorne issued Secretarial Order No. 3270, "Adaptive Management" (dated March 9, 2007) to provide guidance on policy and procedures for using adaptive management in Department of Interior agencies. In response to that order, an intradepartmental working group developed a guidebook to assist managers and practitioners, "Adaptive Management: The U.S. Department of Interior, Technical Guide." It defines adaptive management, the conditions under which we should consider it, the process for implementing it, and evaluating its effectiveness (Williams et al. 2007). You may view the guidebook at: <http://www.doi.gov/initiatives/AdaptiveManagement/documents.html> (accessed May 2011).

The guidebook provides the following definition for adaptive management:

"Adaptive management is a decision process that promotes flexible decision-making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social and economic goals, increases scientific knowledge, and reduces tensions among stakeholders."

This definition gives special emphasis to the uncertainty about management impacts, iterative learning to reduce uncertainty, and improved management as a result of continuous learning. This approach recognizes that we can never achieve perfect understanding of the natural world and that we must implement management in the face of uncertainty. At the refuge level, adaptive management



is an integral part of management planning, research design, and monitoring. Uncertainties about ecological systems are addressed through targeted monitoring of resource response to management actions and predictive models that mimic the function of the natural world.

Adaptive management gives the refuge manager flexibility to adjust management action or strategies if they do not meet goals or objectives. Significant changes from what we present in this final CCP may warrant additional NEPA analysis and public comment. Minor changes will not, but we will document them in our project evaluation or annual reports. Examples of management activities discussed in this CCP that may require an adaptive management approach include actions related to New England cottontail captive rearing and bat hibernacula in bunkers in the former Weapons Storage Area, management of shrubland and impoundments, and stream restoration.

Implementing an adaptive management approach supports all refuge goals. Furthermore, adaptive management is all the more compelling in light of climate change concerns.

## Climate Change

There is consensus among the scientific community that global climate change, occurring in part as a result of emissions of carbon dioxide and other greenhouse gases from human activities, will lead to significant impacts across the U.S and the world (Joint Science Academies' Statement 2005, <http://www.nationalacademies.org/onpi/06072005.pdf>, accessed May 2011). This includes sea level rise adding stress to coastal communities and ecosystems (Wigley 2004). The effect of climate change on wildlife and habitats is expected to be variable and species-specific, with a predicted general trend of species ranges and vegetation communities shifting northward and higher in elevation.

Uncertainty about the future effects of climate change requires refuge managers to use adaptive management to maintain healthy ecosystems in light of unpredictability (Inkley et al. 2004). This involves improving or adjusting policies and practices based on the outcomes of climate change and other monitoring or management activities and may result in changes to regulations, shifts in active habitat management, or changes in management objectives. A few recommendations include (see Inkley et al. 2004 for more recommendations):

- Preparing for diverse and extreme weather conditions (e.g., drought and flood).
- Maintaining or restoring healthy, connected, and genetically diverse wildlife populations to increase resiliency in wildlife and habitats.
- Protecting coastal habitats to accommodate marsh migration in response to sea level rise.

GBNERR and the Great Bay Stewards were awarded a grant to study climate change impacts in the Great Bay Estuary in 2010. We used results from this study to inform our management direction and to support Great Bay Stewards in community outreach efforts aimed at reducing human activities that impact wildlife or habitat migration. We will also pursue the following strategies to reduce our greenhouse gas emissions and help reduce our impact on climate change:

- Support community proposals to develop a regional bike trail. The proposal includes linking a regional trail to the entrance road to the refuge, allowing visitors to reach the refuge using alternative transportation. However, bicycling off-road is not allowed on the refuge.



Greg Thompson/USFWS

*Beaver pond on the refuge*

- Reduce the carbon footprint of facilities, vehicles, workforce, and operations. Some examples include:
  - ✱ Use energy efficient equipment, where feasible.
  - ✱ Maintain buildings using sustainable, green building technologies.
  - ✱ Conduct an energy audit by 2014.

We will help implement the Service's Climate Change Strategic Plan and work with our State and other conservation partners on mitigating and adapting to this conservation challenge. We describe that strategic plan and other important Service guidance on climate change in chapter 1.

## Step-down Plans

Service planning policy identifies 25 step-down plans that may be applicable on any given refuge. We have identified the following plans listed below as the most relevant to this planning process, and have prioritized their completion. Sections of the refuge HMP which require public review are presented within this document and will be incorporated into the final version of the HMP immediately upon CCP approval. The highest priority step-down plans to complete are the HMP, the Annual Habitat Work Plan (AHWP), and the Inventory and Monitoring Plan (IMP). These are described in more detail below. They will be modified and updated as new information is obtained so we can continue to keep them relevant.

The following step-down plans are completed for the refuge and are incorporated by reference into the CCP:

- Chronic Wasting Disease Plan (2008).
- Avian Influenza Disease Contingency Plan (2006).
- Fishery Management Plan (1994).
- Hunt Plan (1993).

We will schedule the completion of the following step-down management plans as shown.

- An HMP, within 1 year of CCP approval (see discussions below on HMP and NEPA requirements; an AHWP will also be generated each year habitat management actions are planned).
- An IMP, within 5 to 10 years of CCP approval (see discussion below).
- A Visitor Services Plan, within 3 years of CCP approval.
- A Law Enforcement Plan, within 3 years of CCP approval.
- A Facilities and Sign Plan, within 3 years of CCP approval.
- An updated Fire Management Plan (FMP), rewritten and completed by 2013.

### Habitat Management Plan

A HMP for the refuge is the requisite first step to achieving the objectives of goals 1, 2, and 5. The HMP will provide more details on the habitat management strategies we will use to accomplish CCP goals and objectives over the next 15 years. In particular, the HMP will detail the specific areas and habitat types we will manage for, as well as the tools and techniques we will use and the timing of our management actions. Additional analysis of the impacts of specific methods may be necessary. The HMP will also incorporate the results of appendix B, which identifies how we derived focal species and habitats for the refuge.

In this CCP, the goals, objectives, and strategies identify how we intend to manage habitats on the refuge. Both the CCP and HMP are based on current resource information, published research, and our own field experiences. Our methods, timing, and techniques will be updated as new, credible information becomes available. To facilitate our management, we will regularly maintain our GIS database, documenting any major vegetation changes on at least a 5-year basis.

#### **Annual Habitat Work Plan**

The AHWP is generated each year from the HMP, and outlines specific management activities to occur in that year. It will detail the tools, techniques, timing of management actions and their specific locations. These plans are also vital for implementing habitat management actions and measuring our success in meeting the objectives.

#### **Inventory and Monitoring Plan**

The IMP will outline and prioritize inventorying and monitoring activities for the refuge. We will use our inventory and monitoring program to assess whether our original assumptions and proposed management actions are supporting our habitat and species objectives. The results of inventories and monitoring will provide us with more information on the status of our natural resources and allow us to make more informed management decisions. The Service's Inventory and Monitoring Policy is currently in draft form, and national and regional staff are currently developing a new template for IMPs. We will incorporate recommendations from the "Strategic Plan for Inventories and Monitoring on National Wildlife Refuges: Adapting to Environmental Change" (USFWS 2010) to ensure a coordinated approach to inventory and monitoring across refuges. The IMP also incorporates the monitoring elements identified under each of the biological objectives.

#### **Visitor Services Plan**

The Visitor Services Plan will build off the visitor services goals, objectives, and strategies included in the CCP. This plan will provide more detailed information on the current visitor services programs; future offerings, programming, and facilities; target audiences; and how we will monitor and evaluate the quality and success of our visitor services programs. It will also identify essential staffing and funding needs, refuge law enforcement needs, and partnerships needed to support the refuge's visitor services programs.

#### **Law Enforcement Plan**

The Law Enforcement Plan provides a detailed assessment of the refuge's law enforcement program and how this program relates to refuge purposes, objectives, and other refuge programs. It will also analyze existing and predicted future law enforcement issues and needs, including staffing, and identify opportunities to cooperate with other law enforcement entities.

#### **Facilities and Sign Plan**

This plan will detail the maintenance of existing facilities and signs, as well as the design and placement of new facilities and signs on the refuge.

#### **Fire Management Plan**

According to Service fire policy, all FMPs should be reviewed annually and updated with current information. Great Bay Refuge's FMP is currently being rewritten and will be completed in 2013.

## Refuge Staffing, Facilities, and Administration

### Staffing and Operational Budgets

Staffing and operations and maintenance funds over the last 5 years are presented in chapter 3. Our objective is to sustain annual funding levels that allow us to achieve our refuge goals, objectives, and strategies. The lack of staff over the last 3 years has limited our capability to conduct priority work, such as major maintenance projects, biological inventory and monitoring, outreach, and public use programs. We will seek to fill the following four approved, but vacant, staff positions which we believe are needed to accomplish our highest priority projects:

1. Assistant refuge manager.
2. Refuge wildlife biologist.
3. Visitor services specialist.
4. Maintenance worker.

If funding is not available, we will continue to seek alternative means of accomplishing our projects, for example through our volunteer program, challenge cost share grants, other partnership grants, or internships.

### Facility Construction and Maintenance

The existing refuge office does not have enough space to serve as both an administrative office and visitor contact station, given our anticipated needs over the next 15 years. Expanding visitor services and resource management will require additional space for both staff and visitors.

To accommodate increases in staff, we propose to construct a new administration/visitor contact facility. We will build the facility in an already disturbed area in the former Weapons Storage Area. The new energy-efficient building will be approximately 7,000 square feet and follow the Service's standard design for a small building and visitor contact facility (see appendix J). The new facility will have space for the four proposed positions. The facility will also have space for two Wapack Refuge staff and a shared refuge law enforcement officer for Parker River, Great Bay, and Wapack Refuges. Finally, it will continue to provide office space for up to four regional office staff.

We also propose to build a separate new maintenance facility, given problems with the existing facility. The existing maintenance area is poorly sited and flooding has been a problem.

### Strategies:

- Relocate the recreational vehicle (RV) pad, used by volunteers as housing, from its present location at the Caretakers Cottage to across from staff residence (at former kennel area); and increase number of power connections.
- Construct maintenance and storage building in a new location.
- Construct a new headquarters/visitor contact station (in the former Weapons Storage Area east of the existing office) to house and support approximately 11 existing and proposed staff positions, as well as seasonal positions.
- Convert all Service roads beyond the residence and maintenance shop from pavement to a more permeable surface, such as gravel.
- Remove existing headquarters building.
- Convert existing shop to storage area.

We will continue to maintain and renovate existing facilities to ensure the safety and accessibility for staff and visitors. Our current facilities are described in chapter 3.

### **Refuge Operating Hours**

We will open the refuge for public use from sunrise to sunset, 7 days a week, with a priority to ensure visitor safety and protect refuge resources. However, the refuge manager does have the authority to issue a special use permit to allow access outside these timeframes. For example, researchers or hunters may be permitted access at different times or in areas that may not be open to the general public. The refuge manager may also permit organized groups to conduct nocturnal activities, wildlife observation, environmental education, and interpretive programs. The Great Bay Refuge office is currently closed to the public because the refuge is unstaffed. The office will remain closed to the public until staff positions are filled.

### **Protecting the Rocky Shore**

Great Bay Refuge has about 2 acres of rocky shoreline near Woodman Point, Thomas Point, and on Nannie Island. This habitat type is important for many bird species of conservation concern, including bald eagles, and we will continue maintain these areas as undisturbed habitat for these species. In particular, Woodman Point is an important roost site for bald eagles wintering on Great Bay.

In April 2011, a new, active bald eagle nest was discovered on Fabyan Point. This is the first bald eagle nest for the refuge. While this nest is not in rocky shore habitat, the bald eagles nesting here will likely use the refuge's shoreline habitat for roosting and perching sites while foraging. Due to the location of the nest site, no management actions have been necessary to restrict public use or access. The only change we have made is to place a gate across the top of Fabyan Point Road, which was already closed to public access. The gate was installed to provide further protection from trespassers who might disturb the nesting pair.

We will continue to implement the following strategies:

- Evaluate the importance of Nannie Island and surrounding waters to migratory birds and other Federal trust resources to determine if the island should remain closed to public access or open for recreation or education purposes.
- Monitor the wintering and nesting bald eagle population on and around the refuge.

### **Special Designations**

#### **Marine Protected Areas**

All coastal national wildlife refuges are part of the national system of marine protected areas (MPA). The goal of the MPA program is to conserve the nation's natural and cultural marine heritage and to ensure the sustainable production of marine resources. Specifically, Great Bay Refuge will continue to support the following MPA conservation objectives:

- Provide reproductive and nursery grounds and foraging areas for fish and shellfish.
- Support areas for migratory birds.
- Provide linked areas important to life histories of marine organisms.
- Offer compatible opportunities for education and research.



## Invasive Species Management

The Service identifies an “invasive species” as a species that is nonnative to an ecosystem, and whose introduction causes, or is likely to cause, harm to the economy, environment, or human health (Executive Order 13112).

The unchecked spread of invasive plants threatens the biological diversity, integrity, and environmental health of all refuge habitats. In many cases, invasive species outcompete native species and become the dominant cover. This reduces the availability of native plants as food and cover for native wildlife. Over the past several decades, government agencies, conservation organizations, and the public have become more aware of the negative effects of invasive species. One report estimated the economic cost of invasive species in the U.S. at \$137 billion every year (Pimentel et al. 2000). Up to 46 percent of the plants and animals federally listed as threatened and endangered have been negatively impacted by invasive species (Wilcove et al. 1998, National Invasive Species Council 2001).

The Service’s Northeast Region initiated an effort to systematically identify, locate, and map invasive plant species occurring on refuge lands leading to an effective integrated management plan. Great Bay Refuge initiated a baseline inventory and mapping of invasive species in 2002. Field surveys during 2002 to 2010 detected 34 invasive species (see table 3.13 in chapter 3). The Refuge will use this information to guide the development of monitoring, control, and eradication projects. When control is deemed necessary, the refuge will use the most effective combinations of mechanical, biological, and chemical controls to achieve long-term control or eradication. Only herbicides approved by the regional contaminants coordinator will be used, and only in accordance with approved rate and timing of application.

Great Bay Refuge is also part of CWIPP, a partnership among 11 agencies and organizations formed in 2008 to address the effects of invasive plants across jurisdictional boundaries. The CWIPP signatories agreed that it was to their mutual benefit and interest to work cooperatively to inventory, monitor, control, and prevent the spread of invasive plants across jurisdictional boundaries within New Hampshire’s coastal watershed. The goal through this cooperative effort is to achieve better management of invasive plants while improving working relationships between the signatories and the public. Great Bay Refuge, although not a signatory to CWIPP, is a “sustaining partner.” Sustaining partners are organizations or agencies with a significant interest in the success of the partnership (<http://des.nh.gov/organization/divisions/water/wmb/coastal/cwipp/index.htm>, accessed May 2011).

We will continue to implement the following strategies:

- Follow the national guidance on invasive species provided in the Service Manual (620 FW 1.7G).
- Complete the inventory and mapping of invasive plant species and prioritize invasive species to be controlled or eradicated. Implement controls using biological, ecological, mechanical, prescribed fire, or chemical techniques, as needed.
- Participate in the CWIPP for early detection and monitoring of invasive species, and become a signatory to CWIPP.
- Work with NHFG to control and remove mute swan from the refuge. The Service goal is zero productivity for mute swans in the Northeast Region, due to the negative impact of this nonnative swan on native waterfowl and their habitats.

*Great egret*

Tim Williams



### **Protecting Cultural Resources**

As a Federal land management agency, we are responsible for locating and protecting cultural resources, including archaeological sites and historic structures that are eligible for the National Register of Historic Places. That applies not only to resources that are located on refuge lands, but also those on lands affected by refuge activities, as well as any museum properties.

To ensure compliance with section 106 of the National Historic Preservation Act, we consult with SHPO on management activities, particularly ground-disturbing activities, which have the potential to impact cultural resources. We prepare a section 106 review report that describes our proposed project, the historic resources that may be impacted, the effect of the project on these historic resources, recommendations for avoiding adverse effect to the historic resources, and mitigation measures in the case where adverse effect cannot be avoided. Mitigation measures may include photographic and written documentation, interpretive exhibits, and archaeological surveys. The section 106 review process also includes public involvement, with information on the undertaking submitted to the Newington Certified Local Government and Newington Historical Society for comment.

We completed Section 106 consultation with SHPO on the CCP (appendix G). We have also initiated a separate consultation with SHPO to assess the National Historic Register eligibility of all structures in the former Weapons Storage Area and the Fabyan Point cabins. We expect this review to be completed within 1 year of CCP approval. If any structures are determined to be ineligible, we will plan to remove them, as funding and staffing allows. The only exception is if the bunkers are determined ineligible, we will plan to keep at least one or two of them for possible use as bat hibernacula. If any of the structures are determined eligible, we will evaluate management options and/or mitigation measures with SHPO.

The Margeson Estate is on the National Register, but is in poor condition due to a lack of funding and resources available to maintain it. Our consultation with SHPO includes evaluating management options and/or mitigation measures for the estate. We have indicated to SHPO that our preferred action is recording the site and then demolishing the buildings. If we pursue demolition, with SHPO concurrence, additional NEPA analysis may be required.

### **Refuge Revenue Sharing Payments**

National wildlife refuges contribute to local economies through shared revenue payments. Federally owned lands are not taxable; but, under the provisions

of the Refuge Revenue Sharing Act, the municipality or other local unit of government receives an annual refuge revenue sharing payment to offset the loss of property taxes that would have been collected if the land had remained in private ownership. In addition, federally owned land requires few services from municipalities, yet it provides valuable recreational opportunities for local residents. As we describe in chapter 3, we pay the town of Newington annual refuge revenue sharing payments based on the acreage and the appraised value of refuge lands. The annual payments are calculated by formula determined by, and with funds appropriated by, Congress. We will continue those payments in accordance with the law, commensurate with changes in the appraised market value of refuge lands, or new appropriation levels dictated by Congress.

### **Findings of Appropriateness and Compatibility Determinations**

Chapter 1 describes the requirements for findings of appropriateness and compatibility determinations. Appendix C includes all approved findings of appropriateness and compatibility determinations for the refuge. These activities were evaluated based on whether or not they contribute to meeting refuge purposes, goals, and objectives.

#### **Activities Not Allowed**

We occasionally receive requests for activities that we do not allow under 50 CFR on Great Bay Refuge. The refuge manager has determined that these activities are not appropriate on the refuge or are sufficiently provided elsewhere nearby on other ownerships. These activities will continue to be prohibited on refuge lands under all alternatives. The only exceptions will be at the discretion of the refuge manager, under specific, special circumstances (e.g., to accommodate visitors with disabilities), and will require the issuance of a special use permit. Appendix C documents the refuge manager's justification for why certain uses are deemed not appropriate. The activities not allowed on refuge lands include: motorized vehicles, bicycles, pets, and horseback riding.

### **Special Use Permits**

The refuge manager will continue to evaluate activities that require a special use permit for their appropriateness and compatibility on a case-by-case basis. All research, commercial, and economic uses, and groups of 10 or more people, require special use permits. In the past, the refuge manager has issued special permits for wildlife inventories, research, hunting, and partner-led educational programs.

### **Additional NEPA Analysis**

For all major actions, NEPA requires site-specific analysis and disclosure of their impacts, either in an EA or an EIS. Most of the major actions in this CCP were fully analyzed and described in enough detail in the draft CCP/EA to comply with NEPA, and do not require additional environmental analysis. Although this is not an all-inclusive list, the following projects fall into this category:

- Biological inventories and monitoring.
- Minor modifications to our public use programs.
- Controlling invasive plants and animal pests.
- A new refuge headquarters and visitor contact facility.
- Extending existing trails.
- Removal of Lower Peverly Pond Dam.
- Converting existing grasslands to shrub habitat to benefit the Federal candidate New England cottontail.

Although we analyzed the impacts of most management actions in the draft CCP/EA alternatives, additional or supplemental NEPA analysis will be necessary for certain types of actions. An example of this is our proposal to expand the hunting program. We analyzed the impacts of the expanded program at a general level, but this analysis will have to be supplemented before a final decision on whether to go forward with the proposed expanded hunt particular

design is reached. Similarly, if we determine the need to remove all three dams along Peverly Brook, adoption of such recommendations will require additional analysis. In each case, these are management actions whose precise details, and therefore consequences, cannot be known by the Service at this time.

### **Interagency Coordination**

As described in chapter 3, refuge lands were formerly part of the Pease Air Force Base. During its use as a base, the lands were highly developed and intensively used. Also, some of the activities on the base created hazardous wastes or environmental contamination. Because of these previous activities, there is a continuing need to monitor for potential environmental contamination on refuge lands. In the interest of protecting wildlife and restoring refuge habitats, we hope to improve the coordination among Federal and State agencies (e.g., the U.S. Air Force, EPA, and NHDES) with an interest and/or responsibility in the clean-up or restoration of the former Pease Air Force Base. In order to accomplish this, we plan to complete the following actions within 1 year:

- Meet with all Federal and State agencies involved in monitoring of environmental parameters with regard to operations of the former Pease Air Force Base on lands now part of Great Bay Refuge. Identify responsibilities of each agency with regard to monitoring, what monitoring is currently being done, where and how often it is being done, what the results have been to date, what has been completed, and anticipated completion dates for future monitoring.
- Determine if all appropriate agreements (e.g., MOU) for contaminants monitoring and/or other actions, such as the removal of buildings in the former Weapons Storage Area, are in place as recommended or required.
- Obtain copies of all contaminants permits, research, and/or monitoring reports and studies associated with the refuge portion of the former Pease Air Force Base, not currently on file at the refuge. Insure that copies of all subsequent documents and reports are automatically sent to the refuge.

### **Land Protection Focus Areas**

During the CCP process, several focus areas were identified by partners and the public for our planning team to consider for Service acquisition. Conservation of lands within these focus areas will support Great Bay Refuge's purposes, and the Refuge System and Service missions, with particular emphasis on protecting species of conservation concern, such as the Karner blue butterfly (federally endangered), the New England cottontail (Federal candidate species), and salt marsh sparrow (a State species of concern), and other Federal trust resources in the Great Bay/Coastal and Concord Pine Barrens ecosystems of New Hampshire.

We will evaluate these focus areas within the next 5 years to assess whether additional land protection is warranted to conserve Federal trust resources and, whether Service land acquisition from willing sellers is recommended. If the review determines that additional land protection by the Service should be pursued then we will initiate all necessary administrative procedures to expand the boundary of the refuge. If the Service's Director grants approval to continue the effort, we will prepare a separate EA and Land Protection Plan (LPP) to analyze all factors involved in a refuge expansion and propose an alternative for public consideration. We expect that any proposal which might emerge from this process will include significant public involvement in decision-making, involve partners in the protection effort, and will utilize the full range of protection methods, including management agreements, conservation easements, and fee acquisition.

We have organized the following discussion of proposed focus areas under two subheadings:

1. Focus areas in coastal New Hampshire.
2. Focus area for Karner blue butterfly near the Concord Pine Barrens.

### **Focus Areas in Coastal New Hampshire**

We have identified several focus areas of high value habitats, including early successional habitat for New England cottontail, and coastal and estuarine salt marsh. In consultation with our conservation partners in the region, we identified these high priority areas:

- *West Dover/East Dover/Rollinsford Focus Areas* (map 4.5): NHFG identified a focus area from the existing Bellamy River Wildlife Management Area in Dover west and east of Route 16 and into Rollinsford, about 5 miles north of the existing Great Bay Refuge. The goals are to recover:
  - ✱ The New England cottontail, a Federal candidate species, before it is listed.
  - ✱ A suite of declining early successional migratory birds, such as American woodcock, whip-poor-will, eastern towhee, brown thrasher, blue-winged warbler, and prairie warbler.
  - ✱ Species of greatest conservation need in the coastal plain of New England, such as Blanding's turtle, black racer, and hognose snake.
- *Great Bay Estuary* (map 4.6): The refuge seeks a more active and expanded role in the GBRPP, particularly in working with interested private landowners on the eastern side of the bay, extending from the current refuge boundaries south to Pierce Point in Greenland and east to the airport. In addition to protecting important habitats along the bay, these lands could offer potential boat access to the bay and opportunities for wildlife observation, hunting, and ice fishing.
- *Hampton-Seabrook-Salisbury Marsh* (map 4.7): The 5,000-acre Hampton-Seabrook Estuary is the largest contiguous area of salt marsh and tidal flats in New Hampshire. It forms the northern part of an extensive salt marsh system that extends south to Cape Ann, Massachusetts. Parker River Refuge is also part of this "Great Marsh." Although the Hampton-Seabrook Estuary is surrounded by development, and affected by ditching and tidal restrictions, it retains significant ecological value and supports a diversity of wildlife (McKinley and Hunt 2008). Several Federal trust species occur here, including a population of breeding salt marsh sparrows.

### **Focus Area for Karner Blue Butterfly in the Concord Pine Barrens**

The Concord Pine Barrens support the only remnant population of the federally endangered Karner blue butterfly in New England. However, the existing 29-acre conservation easement managed by the refuge and lands under a 50-year management agreement with the city of Concord do not provide sufficient habitat to maintain a sustainable wild population (USFWS 2003, Fuller 2008). In consultation with NHFG, the Service has identified significant habitat for the Karner blue butterfly on adjacent lands that are not currently protected (map 4.8). The powerline corridor that runs through this focus area serves as a primary dispersal corridor for the butterfly. The Air National Guard also owns significant land that has suitable habitat for the butterflies. PSNH and the Air National Guard are two important partners in this focus area. Some of the lands under consideration in this focus area would also provide habitat for New England cottontail.



Map 4.5. New England Cottontail Rollinsford and Dover Focus Areas



Map 4.6. East Great Bay Focus Area

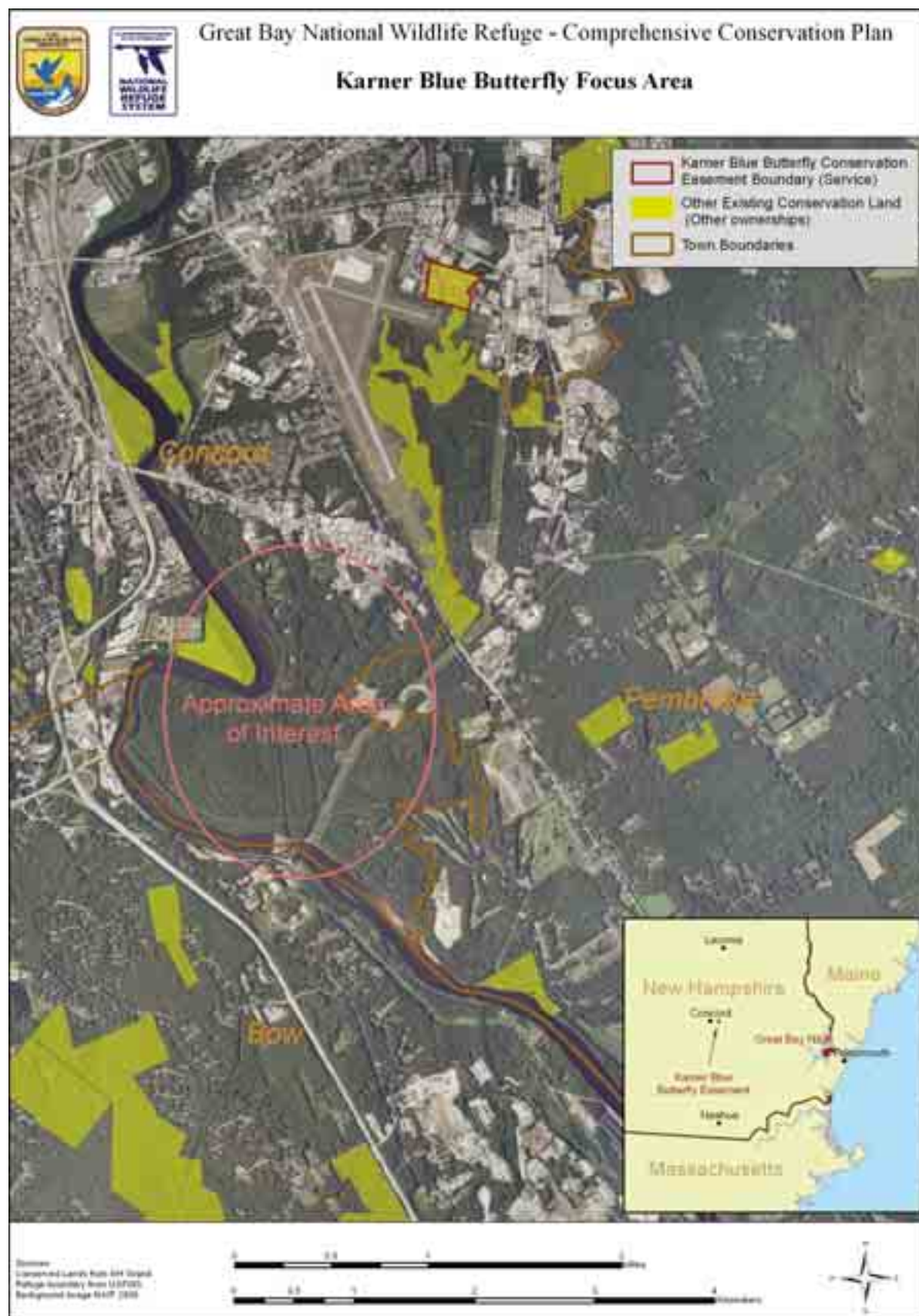




Map 4.7. Hampton–Seabrook–Salisbury Marsh Focus Area



Map 4.8. Karner Blue Butterfly Focus Area





## Goals, Objectives, and Strategies

### GOAL 1.

**Perpetuate the biological integrity, diversity, and environmental health of estuarine and freshwater habitats on Great Bay Refuge to protect water quality and sustain native plant communities and wildlife, including species of conservation concern.**

#### Objective 1.1 Salt Marsh

Annually, maintain the quality and natural function of the 36 acres of salt marsh that supports a mix of native high and low marsh plant species including smooth cordgrass, salt meadow cordgrass, spikegrass, and black grass, with less than 1 percent overall cover of invasive plants, to provide habitat for breeding salt marsh sparrow, wintering American black ducks, foraging wading birds, fish, shellfish, and rare plants.

##### Discussion and Rationale

Several areas of salt marsh occur along the refuge shoreline, with the most extensive located near Woodman Point and Stubbs Pond. The low salt marsh is dominated by smooth cordgrass, while the high salt marsh is dominated by salt meadow cordgrass, spikegrass, and black grass. A healthy population of seaside mallow, a State-listed threatened plant, is found in the salt marsh near Woodman Point (NHB 2010). The salt marsh is relatively free of invasive plants, with the exception of patches of *Phragmites* adjacent to Stubbs Pond.

Up to 80 percent of the marshes that once occurred in New England have been lost to human development. The remaining salt marshes are being rapidly degraded by fragmentation and development (Bertness et al. 2002). Most of the salt marshes in New England, including those found around Great Bay were parallel ditched for mosquito control and to facilitate salt marsh haying. Salt marshes in the Great Bay Estuary occur as expansive meadow marshes and narrow fringing marshes. These marshes provide cover and forage habitats for fish, invertebrates, and birds, stabilize shorelines and protect against storm damage, and filter nutrients (Mills 2009). Protecting the remaining salt marshes is important to sustain habitat benefits, ecosystem services, and wetland functions.

In 1992, prior to refuge establishment, the town of Newington hired a contractor to spray the pesticide Bti on marshes to control the extensive mosquito breeding occurring in areas of the marsh heavily impacted by humans. Beginning in 1996, in an effort to eliminate chemical application on the marshes and restore fish and wildlife habitat, the refuge initiated four OMWM projects. In total, 5.1 acres were implemented at Stubbs Pond, 11.25 acres at Herods Cove, 9.9 acres at Woodman Point, and 3.4 acres at Welch Cove. Project objectives included eliminating invasive plants (*Phragmites* and cattails) restoring native salt marsh vegetation such as wigeon grass, and creating suitable habitat for the mummichog minnow. The mummichog is a native predator of mosquito larvae; a healthy population eliminates or minimizes the need to spray Bti for mosquito control (University of Delaware, 2008).

Various open marsh and water management techniques were used. Ditch plugs were constructed to block man-made drainage ditches and create open water habitat. Pannes (beginning at a depth of 2 inches and gradually sloping to 24 inches) were excavated to increase open water habitat and to facilitate wading bird access. Sumps (2-foot-deep depressions) were excavated within pannes to ensure minnow survival during drought conditions. In some areas, shallow connector ditches were also excavated to allow minnow access between pannes. We have not created any additional OMWM projects since then, as we have completed all the opportunities for OMWM on the refuge.



As presented in chapter 1, the Service's policy on maintaining biological integrity, diversity, and environmental health guides our conservation and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuges (<http://www.fws.gov/policy/601fw3.html>, accessed May 2011). A major principle underlying this policy is to maintain and restore the diversity, structure, composition, and functioning of the refuge's fish, wildlife, and plant species, communities, and ecosystems, as well as biotic and abiotic processes that shape them. We plan to develop an index of salt marsh integrity for the refuge's salt marshes to gather baseline data, and measure our success in sustaining and improving their biological integrity, diversity, and environmental health over time.

Coastal salt marshes provide breeding habitat for black ducks. Specifically, coastal marshes, estuaries, and sheltered coves are especially important foraging habitat and shelter for black ducks in the winter (Dettmers 2006). On average, about 75 percent of New Hampshire's coastal wintering waterfowl gather on Great Bay, including nearly all of the State's Canada geese, greater scaup, and lesser scaup populations, as well as several thousand black ducks (Vogel 1995). The black duck is a globally vulnerable watch list species and is considered one of the highest priority species of concern according to the Atlantic Coast and Eastern Habitat Joint Ventures and among the state and provincial agencies where it occurs.

Virginia rail, red-winged blackbird, sora, salt marsh sparrow, and Nelson's sparrow nest and forage in salt marshes around Great Bay (Mills 2009). The salt marsh sparrow is a species of concern in New Hampshire and of highest conservation concern in BCR 30. The NHB Report (2009) documents an observation in 1997 of eight salt marsh sparrows in the salt marsh off the refuge; two were feeding young in the salt marsh at Woodman's Point. Flooding, particularly during new moon tides, is the primary cause of nest failure for the salt marsh sparrow, which is synchronized to nest immediately after a new moon tide. Vegetation structure and composition are less important in predicting nest success. Females wedge or suspend a nest in medium-high cordgrass just above the substrate or water near the mean high-tide line (Greenlaw and Rising 1994). Another potential threat to this species is elevated mercury levels, which were detected in salt marsh sparrows at other coastal national wildlife refuges (Lane 2008). Walsh et al. (in press) found the population at Chapman Landing, on the west side of Great Bay, was the most genetically differentiated from all populations sampled from Maine to Long Island.

According to the NHDES–Coastal Program (2005a), New Hampshire's salt marshes also provide habitat for other aquatic species, including a wide variety of fish and shellfish (e.g., American eel, mummichog, Atlantic silverside, nine-spine stickleback, shore shrimp, and sand shrimp). Several mammals also use salt marsh habitat including deer, muskrat, river otter, and red fox (NHDES 2005b).

### Strategies

*Continue to:*

- Control any existing and new invasive plant species in the salt marsh using the most effective technique, which could include cutting, hand pulling, biological controls, and herbicide application (e.g., cut and drop or spot treatment).
- Participate in the CWIPP's ongoing identification, monitoring, and eradication efforts for invasive plants in seacoast marshes.
- Prohibit public access to salt marsh habitat on refuge.

*Within 3 years of CCP approval:*

- Develop an index of salt marsh integrity to:
  - ✱ Determine the current baseline integrity condition.
  - ✱ Determine what areas of integrity are low and need attention.
  - ✱ Prioritize management actions to ensure that the index does not fall below the baseline level. The index's parameters may include vegetation richness and diversity, elevation, sediment accretion, salinity, extent of tidal fluctuation, and water quality measures.
- Evaluate all salt marshes that received OMWM to determine integrity of the marshes, with special emphasis on hydrology, climate change impacts, and invasive plants. Assess the effects of the OMWM treatments to determine if they were successful in meeting objectives.
- Collaborate with partners to assess the salt marsh sparrow population around the bay and determine the relative importance of the refuge population to the Great Bay ecosystem and to the larger regional population. Also, partner with UNH to determine how the refuge salt marsh sparrow population fits in the metapopulation structure in New England and throughout the species' range.
- Work with GBNERR to identify and address sources of mercury entering Great Bay, to the extent possible.
- Collaborate with GBNERR on their efforts to establish vertical benchmarks in various low-elevation habitat types within the GBNERR boundary. Promote placing one or more on the refuge. Regular surveying of these benchmarks, coupled with enhanced data from tide gauges, will enable accurate tracking of local sea level rise and anticipate its effects on habitats within the Great Bay ecosystem.
- Provide information to refuge visitors about the environmental sensitivity and importance of salt marsh to the health of the Great Bay Estuary.
- Implement an "early detection rapid response" program that will prevent new invasive species from becoming established within the freshwater tidal marsh by locating newly established invasive species and immediately addressing those populations through the appropriate control measure. This program will incorporate a combination of plant identification and inventories, maintaining updates of new invasive species present in the region, as well as having knowledge of the appropriate management techniques prior to conducting control efforts.
- Partner with BRI or other organizations to test if mercury levels are high in the refuge's salt marsh sparrow population, as one indicator of ecological health.
- With volunteers and partners, conduct fall waterfowl migration surveys, and mid-winter waterfowl surveys to the extent access is possible, of black ducks and other waterfowl to assess the importance of the refuge to regional migrating populations.

**Monitoring Components**

- Annually monitor the salt marsh habitat for presence of invasive plant species.
- Establish and implement monitoring protocol to track changes in salt marsh biological integrity against its baseline index.

- Work with GBRPP, GBNERR, and other partners to use SLAMM or other modeling results to develop a monitoring program that will evaluate conditions in the region's salt marshes over the next 15 years with respect to climate change and sea level rise.
- Work with partners to develop and implement a monitoring plan to identify breeding activities, abundance, and densities of salt marsh sparrows in Great Bay, inclusive of the refuge.
- Work with NHFG to monitor migrating and wintering waterfowl.
- Establish and implement monitoring program to assess health and distribution of rare plant populations.

## Objective 1.2 Intertidal and Shallow Estuarine Waters

Work with partners to protect and restore the health and function of the intertidal habitats in Great Bay Estuary, including enhancing water quality to benefit fish, shellfish, breeding and wintering bald eagles and waterfowl, and other estuarine life, such as oysters, soft-shell clams, and horseshoe crabs. Emphasize the restoration and maintenance of 2 acres of oyster beds around Nannie Island and Woodman Point, as well as the eelgrass beds.

Refuge-specific support of regional objectives will include:

- Contribute to the PREP CCMP's goal of 50,000 bushel of adult oysters (greater than 3.2 inches in size) by 2020 by supporting 25,000 bushels of adult oysters in the Nannie Island area in the same time period.
- Contribute to the PREP CCMP's goal of restoring eelgrass cover to 2,900 acres and restoring connectivity of eelgrass beds throughout the Great Bay Estuary by 2020, by restoring the extent of eelgrass bed in Herod Cove and western shoreline of the refuge and increase eelgrass percent cover to a minimum of 60 percent for both beds.
- Contribute to protecting the water quality of the bay to provide migrating and watering habitat for waterfowl and breeding and wintering habitat for bald eagles. Support partner efforts to provide areas for waterfowl and bald eagles where they can nest, forage, and roost without human disturbance.

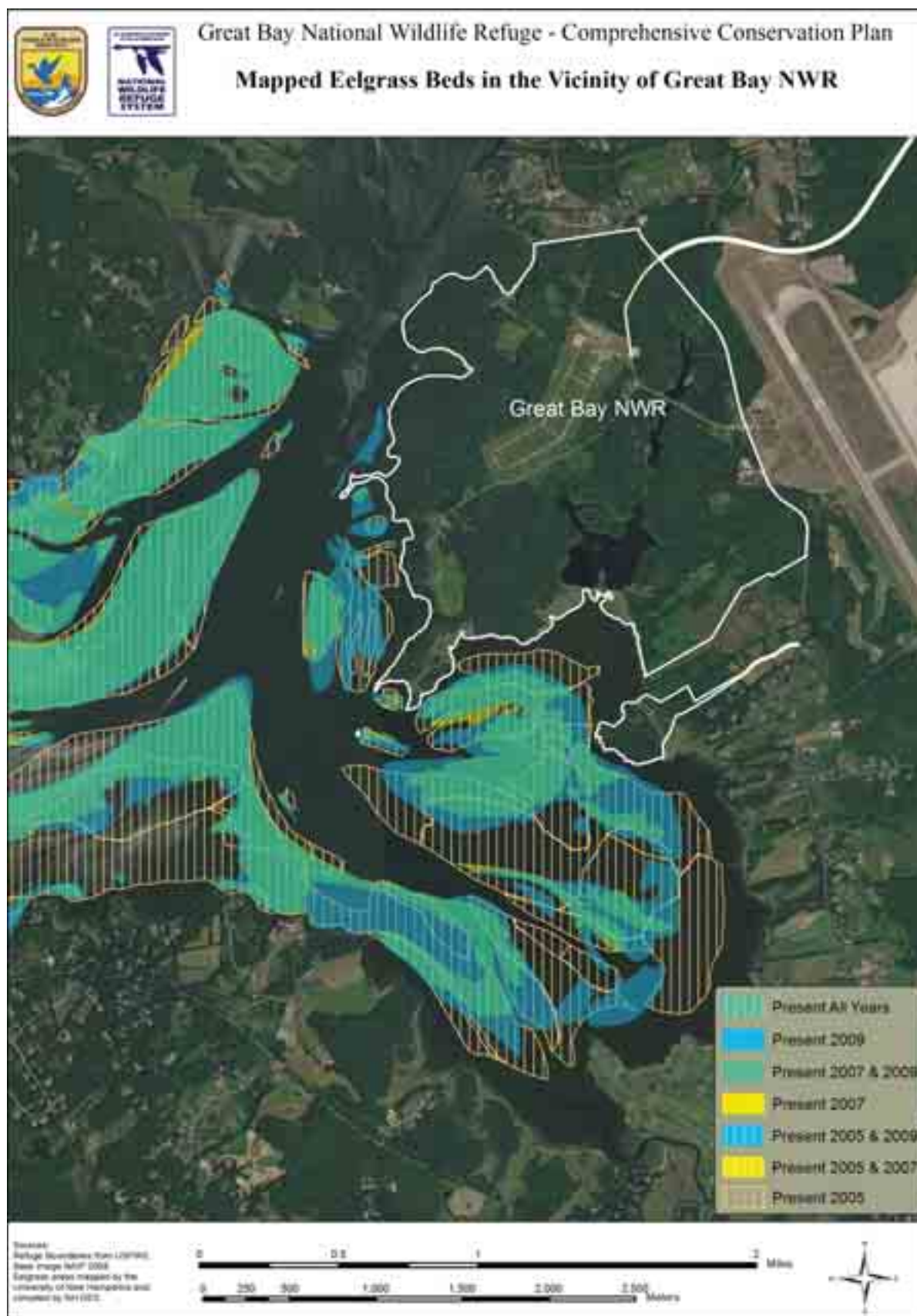
### Discussion and Rationale

Both eelgrass beds (map 4.9) and oyster beds (map 4.10) are regarded as keystone and indicator species for Great Bay Estuary. A keystone species is a species that plays a critical role in maintaining the structure and diversity of an ecological community and whose impact on the community is greater than would be expected based on its relative abundance or total biomass. Indicator species are plants and animals that, by their presence, abundance, lack of abundance, or chemical composition, demonstrate the quality of the environment.

Oysters, as long-lived filter feeders, are able to filter nutrients and pollutants to help maintain water quality and clarity in estuaries. Oysters accumulate in dense groups called beds or "reefs." These reef habitats provide homes or cover for other fish and crustaceans. Close to shore, oyster reefs serve as natural breakwaters, easing the impact of waves and boat wakes on shorelines.

Historical records document extensive oyster beds in most of Great Bay's tributaries and many channels within the bay. Hundreds of years of pollution, siltation, and harvest led to sharp declines in oysters throughout the bay (Mills 2009). More recent threats include two parasitic protozoa, *Haplosporidium*

Map 4.9. Mapped Eelgrass Beds in the Vicinity of Great Bay National Wildlife Refuge





*Map 4.10. Current Shellfish Beds in the Vicinity of Great Bay National Wildlife Refuge*

*nelson* (MSX) and *Perkinsus marinus* (Dermo). A major decline of oysters in Great Bay beginning in the early 1990s is thought to be caused by these protozoa. The population fell from 125,000 bushels in 1993 to 6,174 bushels in 2000; the population has since recovered to 10,044 bushels (PREP 2009). Oysters filter about 20 gallons of water per day, which has major implications for the health of the Great Bay Estuary. In 1970, the oyster population could filter the estuary's water in 4 days. Today, with the reduced population, it takes 100 days or more (Mills 2009).

PREP established a management goal of 50,000 bushels of adult oysters or 10 million adult oysters by 2020 (PREP 2010). The largest oyster bed in Great Bay is located near Nannie Island, supporting almost 100,000 bushels of adult oysters in 1993 (map 4.10) (PREP 2009). This reef declined in area by 33 percent between 1997 and 2000, while a much smaller bed at Adams Point expanded by over 200 percent during the same period. In 2007, UNH constructed 12 mini-reefs (from recycled oyster shells), seeded with 1.2 million oyster spats, in a 1.75 acre area just north of Nannie Island. The Nannie Island restoration area experienced increased oyster densities from 2007 to 2009 due in large part to the exceptional 2006 natural recruitment observed throughout Great Bay (PREP 2009).

Eelgrass is an essential habitat in Great Bay Estuary and the basis of an estuarine food chain, providing food for migrating and wintering waterfowl and habitat for juvenile fish and invertebrates (map 4.9). In winter, eelgrass is dormant with much of its energy reserves tied up in the underground root or rhizome. This carbohydrate-rich food source is relished by wintering geese and ducks (Smith 2004). Eelgrass beds are particularly important to juvenile rainbow smelt, Atlantic silversides, nine-spined sticklebacks, alewife, and blueback herring. Larger fish and wading birds are attracted to the smaller fish that hide within the eelgrass beds. The long narrow leaves of eelgrass slow water flow and filter suspended sediments from the water column (Short et al. 1992a).

In 1989, there was a dramatic decline in eelgrass beds to only 300 acres. This decline was linked to an outbreak of a slime mold (*Labryrinthula zosterae*), commonly called "wasting disease." Although the eelgrass beds originally recovered from the outbreak (back up to 2,000 acres in 1996), the eelgrass beds are again in a slow and steady decline. Between 1990 and 2008, the eelgrass cover in Great Bay declined by 37 percent and eelgrass biomass by 64 percent. By 2008, eelgrass was gone from Little Bay, the Winnicut River, and almost entirely from the Piscataqua River (PREP 2010). Eelgrass beds remain offshore from the refuge, although greatly diminished from 1996 levels. The loss of eelgrass beds has major implications for the health of the Great Bay Estuary, affecting water quality and habitat suitability for eelgrass-dependent species. Nutrient loading and increased turbidity from suspended sediments are considered two of the limiting factors to restoring eelgrass to the bay (PREP 2009).

Soft-shell clams are another important food source for wintering waterfowl, particularly diving ducks (map 4.10). A large clam flat is located in Herods Cove. Clam populations in Great Bay have fluctuated due to harvest pressures, invasive predators (such as the nonnative green crab) and diseases (such as "neoplasia").

Another interesting invertebrate found in Great Bay is the horseshoe crab, which is not a true crab. Horseshoe crabs spawn in late spring and early summer on the shores of Great Bay. In some places along the East Coast, horseshoe crab eggs are a valuable food source for nesting terns and wading birds and migrating shorebirds. Their distribution and ecological role in the Great Bay Estuary is unclear.

The bay is one of the primary bald eagle wintering areas in New Hampshire, contributing roughly 20 percent of the total eagles counted in the State during the mid-winter bald eagle survey (Martin 2011 personal communication). Eagles use large trees on the refuge, particularly dead or alive white and red pine as daytime perches, roost sites, and for nesting. As of 2010, there were 14 total nesting pairs of bald eagles in the State (NH Audubon 2010). In 2011, a pair of bald eagles nested on the refuge adjacent to the bay, and successfully fledged one chick. This is the first time in decades that bald eagles have nested on the refuge. The bay also supports the largest concentration of wintering waterfowl in the State, with thousands of waterfowl using the bay at any one time. To provide undisturbed habitat for waterfowl and eagles, the refuge restricts public access to the shoreline.

### Strategies

*Continue to:*

- Organize annual shoreline cleanup on the refuge with the help of volunteers.
- Restrict public access to the shoreline to provide buffer and undisturbed roosting, foraging, and breeding habitat for waterfowl and bald eagles.

*Within 3 years of CCP approval:*

- Begin working with NHFG and other Great Bay partners to restore oyster beds near Nannie Island and Woodman Point. This includes assessing the current status of the oyster reef and restoring the reef through existing or experimental methods such as augmenting the reef with spent clam shells or other material and seeding with oyster “spat” (young oysters).
- Begin working with NHFG, UNH, and other Great Bay partners to restore eelgrass bed west of Woodman Point and at Herods Cove. This includes assessing the current extent and percent cover of eelgrass beds and restoring beds by transplanting eelgrass.
- Begin working with NHFG, NHDES, and Great Bay partners to reduce nutrient and sediment loading into Great Bay, which affects water quality and in turn affects oysters, eelgrass, and other aquatic life, with particular emphasis on oyster and eelgrass beds in Herods Cove.
- Work with NHFG to protect the clam flats in Herods Cove from overharvest through cooperative enforcement of State regulations on shellfish harvesting.
- Study the importance of the refuge shoreline as spawning and nursery habitat for horseshoe crabs; partner on assessing the health of horseshoe crab population in the estuary.
- Assess the need for additional protection for nesting bald eagles from human disturbance. If necessary, work with NHFG and other partners to provide additional buffer from recreational bay user.

### Monitoring Components

- Work with partners to monitor the health and distribution of the oyster beds near Nannie Island and Woodman Point.
- Assess the Herod Cove clam flat to determine area of clam bed, density, and populations.
- Work with partners to monitor the health and distribution of eelgrass beds near the refuge.

- Work with partners to monitor the presence of nonnative invasive aquatic organisms, such as the green crab, to minimize impacts on native shellfish.
- Conduct annual horseshoe crab surveys at spawning sites on Great Bay, consistent with approved State or regional protocols. Shoreline protocols are currently being developed by the University of Rhode Island and the State of New Hampshire.
- Work with GBNERR and PREP to monitor water quality within the Great Bay Estuary as indicator of ecological health.

### **Objective 1.3 Freshwater Impoundments and Peverly Brook System**

Manage the 62-acre Peverly Brook system on the refuge to improve water quality, establish a more natural flow regime, improve migratory and resident fish habitat, and maintain habitat for waterfowl, marshbirds, and other aquatic life.



Matt Poole/USFWS

*Wetlands on the refuge*

#### **Objective 1.3a Stubbs Pond**

Annually manage the existing 44-acre Stubbs Pond to maintain a diversity of native emergent marsh vegetation (e.g., cattails, arrowhead, wild rice, and softstem bulrush) with 30 to 50 percent open water and less than 5 percent invasive plant species (e.g., purple loosestrife and *Phragmites*) to benefit migrating waterfowl such as black duck, nesting marsh birds such as marsh wren and Virginia rail, raptors such as bald eagles and osprey, and migratory fish, including American eel, alewife, and blueback herring. Specific habitat targets include:

- Annually support migratory waterfowl through a mix of water depths, flooded vegetation (cattail, wild rice, and softstem bulrush) at peak fall migration (late October).
- Annually maintain a high water level in Stubbs Pond during the summer months to maintain 50 to 70 percent native emergent vegetation (cattail, wild rice, and softstem bulrush) and provide breeding habitat for marsh and wading birds.
- Annually provide migratory fish (alewife and blueback herring) access to spawning habitat in Stubbs Pond by maintaining a minimum of 1.0 feet of running water through the fish ladder structure from late April to mid-July, or until water level is insufficient for fish passage.

#### **Objective 1.3b Upper Peverly Pond**

Annually maintain the existing 11-acre Upper Peverly Pond to provide wildlife observation opportunities, and to benefit migrating waterfowl, including wood duck, ring-necked duck, and green-winged teal, and to provide nursery habitat for American eel. Establish evaluation criteria, and regularly evaluate the environmental conditions of this pond to determine the desirability and feasibility of its future removal.

#### **Objective 1.3c Lower Peverly Pond**

Within 5 years of CCP approval, remove the failing dam and other associated infrastructure at Lower Peverly Pond, and restore the existing 7-acre pond to 1,100 feet of native riparian habitat, reconnecting a portion of a fragmented river



system, reestablishing natural streamflow, and enhancing habitat for migratory native fish.

### Discussion and Rationale

The 1.52-mile Peverly Brook begins a few thousand feet north of the refuge boundary. The 907-acre watershed is the largest watershed in the town of Newington and was once a drinking water source for the city of Portsmouth. The city diked Peverly Brook around 1900 to serve as a water supply, creating Upper and Lower Peverly Ponds. The Air Force acquired the lands encompassing Peverly Brook in 1952 and managed the three freshwater impoundments for mosquito control and recreation. We describe the history of the impoundments under Air Force ownership in chapter 3 in the section on “Freshwater Impoundments.”

According to the Service’s New England Ecological Services Field office (NEFO), contaminants have not migrated any lower down the watershed and the contaminant levels in Lower Peverly and Stubbs Ponds meet clean-up goals (Drew Major, NEFO 2011 personal communication). However, prior to any dam removals we will conduct additional sediment and water quality testing to ensure safe levels.

Since refuge establishment, the three impoundments in the Peverly Brook drainage have been managed primarily to benefit spring and fall migrating waterfowl and marsh nesting birds. We will expand our management to include enhancing water quality, improving habitat for migratory and resident fish, and maintaining habitat for waterfowl, marsh birds, and other aquatic life. Specific strategies will be detailed in the HMP, such as water level management (e.g., timing, season, and desired water level) and invasive species treatments.

In chapter 3, in our discussion on freshwater impoundments, we provide a summary of the 2006 SEED report which identified concerns with the three impoundment infrastructures, but also included recommendations for improvement. Our summary in chapter 3 also includes what work we have been undertaking to date to address those concerns and implement recommendations.

*Stubbs Pond:* As part of this CCP process, we reviewed the benefits and consequences of maintaining Stubbs Pond as a freshwater impoundment versus breaching the dike and restoring it to a saltwater system. According to NHFG, Stubbs Pond is unique within the Great Bay Estuary system, given its large size (44 acres of freshwater wetland) and established population of wild rice. The State-listed plant large bur-reed is found in Stubbs Pond. There are no other places in coastal New Hampshire that draw in the amount and diversity of waterfowl documented at Stubbs Pond, especially mallards and black ducks during spring and fall migration (Ed Robinson, Waterfowl Biologist, NHFG 2011 personal communication). A recent study commissioned by the Service reported that Stubbs Pond is unlikely to be affected by sea level rise as a result of climate change over the 15-year life of the CCP (Clough and Larson 2009), but a more detailed analysis is needed.

Water level manipulation is used in Stubbs Pond to manage the ratio of vegetation to open water and to control undesirable vegetation including invasive plants. The objective is to control the monoculture of cattail vegetation and increase vegetation diversity, opening up areas to increase the ratio of open water to emergent vegetation while controlling invasive purple loosestrife and *Phragmites*. Water level management has fluctuated from year to year, in part because of the difficulties in managing Stubbs Pond. A new water control structure was installed in 1996. Since then, refuge staff have used various techniques to control excessive cattail growth and to strive for a 50:50 balance of aquatic vegetation and open water. Techniques included mowing, manipulating water levels

(drawdowns and flooding), using herbicides to control cattails, and releasing *Galerucella* beetles to control purple loosestrife.

After several years of using these techniques, refuge staff concluded that spring drawdown of Stubbs Pond allows cattail and purple loosestrife to increase, while inhibiting other more desirable species, such as large bur-reed, soft stem bulrush, wild rice, wild celery, and arrowhead. Our experience indicates that Stubbs Pond should be kept relatively high during the spring and summer to discourage cattail growth. A drawdown in early fall benefits migratory birds. If weather permits, it may be possible to mow, spray, or burn cattail stands in the fall before refilling the pond in the winter to early spring.

A fish passage structure was installed in 1995 in Stubbs Pond but was not operated until the spring of 2003. The fish passage is now opened in late April to allow alewife and blueback herring to migrate into Stubbs Pond. Our volunteers have documented blueback herring migrating through the fish ladder during May.

Five years (1999 to 2003) of marsh bird surveys were conducted on the refuge. Virginia rail, least bittern, sora, common gallinule, pied-billed grebe, king rail, and marsh wren were recorded in Stubbs Pond. The amount of emergent wetland habitat has declined significantly throughout North America along with apparent declines of marsh-dependent birds. Changes in water levels, ratios of mud flats to open water areas, invertebrate communities, and amount of emergent plant cover in marsh habitats could affect habitat quality for marsh birds. Given the variability of rainfall, annual vegetation changes, and the varying needs of priority species, we will continue to use adaptive management and annually modify water levels as needed to create appropriate seasonal habitat conditions for the full suite of species, including waterfowl, marsh birds, and migratory fish.

In order to establish a baseline and improve our water level management in Stubbs Pond, we plan to map the bathymetry (the underwater elevations) of Stubbs Pond, relative to the dike, spillway, fish ladder, water control structure, brook, and salt marsh. This information will help us determine how to manipulate the pond's water levels to meet our objectives for migratory birds, fish passage, and other resource values. It will also help us establish a baseline from which to measure changes that might occur due to climate change, such as sea level rise or other processes that might result in subsidence or deposition in areas.

We will also work with partners to evaluate the effectiveness of the fish ladder and determine if there are practicable opportunities to enhance the movement of fish migrating through. Examples of improvements that have been recommended, but need further analysis, include the following:

- Create an attraction jet to guide fish to the ladder.
- Install a nature-like bypass to provide additional passage for American eel, alewife, and blueback herring.
- Install additional sections of the "steepass" ladder.
- Determine if a new design or retrofit could allow fish to pass at a greater range of tides.

The existing fish ladder was designed to only pass fish at high tide because at lower tides fish cannot cross the tidal mudflats to reach the ladder. It would be very difficult and costly to provide fish passage at a wider range of tide levels (Brownell 2011 personal communication).

*Upper Peverly Pond:* The 11-acre Upper Peverly Pond is used as a foraging and resting site during migration by a small number of waterfowl and marsh and wading birds (great blue heron, wood duck, bufflehead, ring-necked duck, and green-winged teal). It provides nursery habitat for American eel during its elver stage. American eel is a declining species that spends most of its life in fresh or brackish water, then travels downstream and far offshore to the Sargasso Sea where it spawns.

A new water control structure was installed on Upper Peverly Pond in 1999 to control water levels to benefit waterfowl. The pond was drawn down several times during spring for moist soil management with positive vegetative and waterfowl population response to this management. The vegetation in and around Upper Peverly Pond seems to be more stable than in Stubbs Pond. In 2004, the invasive brittle water nymph was discovered in Upper Peverly Pond. Brittle water nymph is an annual invasive plant with no easy control methods. Upper Peverly Pond is maintained primarily as open water habitat, with minimal water level management.

We plan to maintain the dam on Upper Peverly Pond for several reasons. There are still contaminated sediments remain in Upper Peverly Pond and trapped behind the dike. We are concerned that removal of the dam in the near future would release these sediments downstream with unknown environmental impacts and would likely diminish habitat for American eel as well as waterfowl. However, we will establish evaluation criteria, and regularly evaluate the environmental conditions of this pond to determine the feasibility of its future removal.

*Lower Peverly Pond:* The 7-acre Lower Peverly Pond has an antiquated spillway that is deteriorating and has no water control capabilities. Also, beaver activity in the area is significantly affecting the integrity of the dam and accelerating the likelihood of total failure. The current risk that the dam might fail is high. We plan to remove the dam at Lower Peverly Pond because of the expense to upgrade it to current safety standards, compared to the minimal value to Federal trust resources. The use of this pond by waterfowl, wading birds, and other species of concern is low. A limited number of waterfowl, including a few wood, black, and ring-necked ducks, and bufflehead, are seen during the spring and fall migration. We predict that we could recover and restore to near natural conditions approximately 1,100 feet of stream if the dam were removed.

Although removal of the Lower Peverly Dam might diminish some habitat for American eel, the presence of active beaver in the system will likely function similar to the existing dam, and might allow for improved eel passage (Douglas Smithwood, Fishery Biologist, USFWS 2009 personal communication). Furthermore, removal of the failing Lower Peverly Pond Dam is consistent with a proposal presented in a letter to the Service from the NHDES in 2007. That letter clearly stated that reconstruction of the dam would not be beneficial to aquatic life in Peverly Brook or Stubbs Pond. Rather, breaching the dam would remove the threat of dam failure and eliminate continued downstream erosion from the Lower Peverly spillway. The letter further noted that dam removal would improve the water quality in Peverly Brook and provide additional stream habitat for spawning blueback herring and other fish species. In addition, dam removal would be consistent with the Coastal Zone Management Act (Christian Williams, NH Coastal Program 2007 personal communication).

Contaminant levels associated with the former Air Force Base have decreased enough that they are close to or meet clean-up targets. The Upper Peverly Pond Dam has acted as a sediment trap, preventing some contaminants from moving downstream. The removal of the Lower Peverly Pond Dam should not exacerbate any existing contaminant issues below Lower Peverly (Drew

Major, Contaminants Specialist, NEFO, personal communication with Graham Taylor, Dec 12, 2009; see appendix I). We will conduct pre- and post-dam removal sampling to establish a baseline and measure any impacts to water and contaminants resulting from dam removal. Brittle waternymph was found in Lower Peverly Pond in 2004. We will also evaluate control methods prior to removal of the Lower Peverly Pond Dam.

We do not have a detailed plan for the dam removal at present. We will work with NHFG, NEFO, NHDES, and the Service's Central New England Fisheries Resource Office to coordinate the design. We will also consult with the SHPO to determine if Lower Peverly Dam is eligible for the National Register and to minimize any potential impacts of its removal on cultural resources. We expect the work will occur in late summer during low flow and drier conditions. Our concept will be to remove the concrete spillway using excavators and then use some of the earthen material to reconstruct and contour the uplands to begin restoration of a forested riparian area. Some recontouring of the stream channel will also likely be necessary to recreate the original stream channel and bed, or to approximate it the best we can. In our estimation, approximately 150 feet of stream reach will be included in the project area. We hope to coordinate with the Coastal America program to implement the project.

### Strategies

#### *Continue to:*

- Work with partners at the headwaters of the Peverly Brook system to improve water quality and ensure water quantity.
- Prioritize and control invasive plants (e.g., *Phragmites*, purple loosestrife, brittle waternymph) within the Peverly Brook system using mechanical (e.g., mowing), biological, chemical, prescribed fire, and ecological methods. Chemical controls are used as a last option if the other techniques are not effective.
- Use adaptive management in Stubbs Pond and Upper Peverly Pond to maintain an optimal mix of open water and aquatic vegetation (approximately 50 percent of each) to benefit breeding and staging waterfowl, marsh and wading birds, fish, and rare plants. Specific water level manipulations will be prescribed in the AHWP, based on existing conditions at the time.
- Annually maintain dikes, dams, spillways to ensure integrity of structure and address any items identified in the periodic SEED assessments (last done in 2006). Annually maintain and inspect water control structures and emergency valves (See "Freshwater Impoundments" section in chapter 3 for details on current and proposed maintenance of the dams).
- In partnership with NHFG, control mute swans, a nonnative species that negatively impacts local plants and waterfowl.

#### *Within 3 years of CCP approval:*

- Work with NHFG and the Service's Central New England Fisheries Program to evaluate effectiveness of the fish ladder and determine if there are practicable opportunities to enhance the movement of fish migrating through the ladder from late April to mid-July given the constraints of tidal flow and with consideration for maintaining quality, open water habitat for migratory birds. If this evaluation recommends that the fish ladder be updated or repaired, we will implement those recommendations within 3 years of the review, or as soon as funding allows.



- Work with Service's NEFO to monitor contamination and identify remediation options for Upper Peverly Pond. Develop evaluation criteria and regularly evaluate the environmental conditions of this pond to determine the feasibility of its future removal.
- Work with partners to detect and remove "hot spots" of DDT contamination in Upper Peverly Pond, if determined feasible, and contingent upon funding and staffing.
- Seek technical and financial assistance from partners with project design and implementation to remove the Lower Peverly dike and restore that section of the Peverly drainage. Consult with the SHPO to determine if Lower Peverly Dam is eligible for the National Register and to minimize any potential impacts of its removal on cultural resources. Work with NHFG, NHDES, NEFO, and the Service's Central New England Fisheries Program to plan and design the removal of impoundment structure and restoration of brook, including stream channel and adjacent riparian area. Begin all requirements to obtain permits for the work.
- Prevent infestation of invasive species during and after the dam removal at Lower Peverly. Use early detection rapid response techniques.
- Complete bathymetry study of Stubbs and Upper Peverly Ponds to help refine impoundment management on those ponds.
- Relocate, or construct an additional, osprey platform at Stubbs Pond in order to encourage nesting away from the dike and to minimize the disturbance to nesting birds caused by management activities.

*Within 5 years of CCP approval:*

- Assuming funding is secured, remove Lower Peverly Pond Dam and restore the existing 7-acre pond to stream and adjacent riparian habitat. Prior to dam removal:
  - ✱ Evaluate the extent of brittle water nymph in the impoundments and determine control methods.
  - ✱ Assess Lower Peverly Pond for water and sediment contamination. If levels do not pose a concern for refuge resources, begin required permitting process for dam removal.
  - ✱ Arrange assistance with Coastal America program to help during construction and restoration phase.
  - ✱ Within 15 years of CCP approval:
    - Develop a protocol for ongoing evaluation of Stubbs Pond to develop criteria and thresholds, or triggers, that would lead to a shift in management and/or restoration to a tidally influenced system based on regional landscape context, contribution to Federal trust resource conservation, potential management implications, and commitments, and long-term solutions to contaminant issues.

**Monitoring Components**

- Monitor water levels in Stubbs Pond and Upper Peverly Pond, 1 to 2 times per week, year-round as feasible (i.e., if open water).

*Beaver activity on  
the refuge*



- Check fish ladder several times a week from late April to mid-July and weekly from September to November for structural condition and fish use. Discuss the possibility of using automated monitoring with staff from the Service's Fisheries Program.
- Conduct a Water Resource Inventory and Assessment following the National Service standards to determine current water conditions (quality and quantity) and needed future monitoring.
- Weekly monitor osprey and bald eagle nest during nesting season.
- Conduct sediment and water quality monitoring in the Peverly Brook system from Lower Peverly to Stubbs Ponds to establish pre-dam removal baseline. One year after the removal of the Lower Peverly Dam, conduct post-dam removal monitoring impacts in Stubbs Pond.
- Annually monitor the migratory fish populations and movement in the Peverly Brook system.
- Monitor sediments and water quality in the Peverly Brook system for contaminants every 3 to 5 years.
- Develop a monitoring protocol to assess current habitat condition of Lower Peverly Pond and adjacent habitats, and monitor vegetation community change after dam removal.
- Develop a protocol for ongoing evaluation of Upper Peverly Brook to determine if pond should be dredged, maintained as is, or breached. Establish thresholds or triggers that will lead to a shift in management based on regional landscape context, contribution to Federal trust resource conservation, potential management implications and commitments, changes in visitor services, long-term solutions to contaminant issues.
- Map and monitor invasive plants in the Peverly Brook system, and update every 5 years.

- Work with the New England Wildflower Society and other partners to establish and implement a protocol for routine monitoring of rare plant populations documented by NHB in Stubbs Pond including large bur-reed and stout bulrush.
- Work with the Pease Airport Authority to establish regular monitoring of potential runoff from the airport into the Peverly Brook watershed, particularly potential runoff from the new de-icing pads.
- Collect baseline information on freshwater mussels in the impoundments and potential impacts from water level drawdowns and restoration.

## GOAL 2.

**Perpetuate the biological integrity, diversity, and environmental health of upland and forested wetland habitats on Great Bay Refuge to sustain native plant communities and wildlife, including species of conservation concern.**

### Objective 2.1 Appalachian Oak-Hickory Forests

Maintain the biological integrity, diversity, and environmental health of the refuge's 700 acres of mature Appalachian oak-hickory forests to provide habitat for breeding and migrating birds of conservation concern including scarlet tanager, Baltimore oriole, wood thrush, and breeding and migrating forest bats. Ensure less than 10 percent of total vegetation cover is invasive plant species (e.g., common buckthorn, common barberry, glossy buckthorn, and winged euonymus).

#### Discussion and Rationale

In appendix B (part 1.3), we detail the process we used to determine what elements comprise the biological integrity, diversity, and environmental health for each of the refuge's plant communities. We reviewed historical conditions, site capability, the current regional landscape conditions, and the biological diversity on the refuge. We also considered natural processes and limiting factors which could potentially affect each plant community.

Many of the forests on Great Bay Refuge have a recent agricultural history and are dominated by successional white pine or hardwoods. Although pine, hardwoods, and mixed stands are clearly evident, the current overstory dominant tree species are not necessarily the best indicator of what natural community types occurred on the refuge. White pine stands are common and are generally a stronger indication of past land use history than they are of the long-term potential of a site. NHB used the total composition of plant species, in combination with soil attributes, to indicate community type (Sperduto 2000).

Dry Appalachian oak forests are characterized by southern (or "Appalachian") species that reach the northern extent of their ranges in southeastern New Hampshire and southern Maine. The typical dominant trees in this forest type include a mix of oaks, such as red, black, and white oaks, and the somewhat less abundant shagbark hickory. The shrub layer is dominated by flowering dogwood, mountain laurel, and American hazelnut. Pennsylvania sedge may form extensive "lawns," contributing to a park-like setting. This community supports a high diversity of herbaceous plants, including numerous State rare species, such as sweet goldenrod, birdfoot violet, hairy bedstraw, reflexed sedge, slender knotweed, fern-leaved false-foxglove, Maryland tick-trefoil, and prostrate tick-trefoil.

The mesic Appalachian oak-hickory forest on the refuge is documented as an exemplary natural community, according to NHB. This community type includes a mix of Appalachian hardwoods, as described above, and "transitional" hardwoods, such as beech, birches, and maples. Hemlock and white pine occur in

variable amounts in both forest types. The mesic oak-hickory forests tend to have a more diverse forest canopy compared to the dry oak forest. The mesic forest occurs in two variants, both of which occur on the refuge. The dry-mesic variant occurs on well-drained fine sandy loam soils where beech, paper birch, and some dry-site herbs are more frequent. The mesic variant is more common on silt loam soils with more moisture, where white ash and black cherry might be more prevalent (Sperduto and Nichols 2004).

Oak forests were not dominant in the Northeast pre-human settlement. Burning by Native Americans may have increased oak dominance in certain forests. European settlement further increased oak dominance through logging, land clearing and the introduction of chestnut blight (Abrams 1992). Oak and hickory are early to mid-successional species that depend on fire or disturbance for regeneration. Abrams (1992) suggested a fire frequency of 50 to 100 years in pre-settlement oak forests to sustain oak species. Some of these forests may transition to other overstory species in time due to lack of adequate red oak regeneration, and from increases in beech on drier sites and sugar maple and beech on more mesic sites. Repeated fire will tend to knock back fire-sensitive species like beech and sugar maple. As such, any natural, semi-natural, and/or controlled fire regimes may be necessary for the long-term maintenance of oak and hickory on some sites (Sperduto and Nichols 2004). However, projected changes to natural processes under climate change predictions (northward shift of ecosystems and increased likelihood of natural fires) may maintain this habitat.

Appalachian oak forests are important to many wildlife species given the abundance of nut-bearing oaks and hickories. These rich foods are eaten by wild turkey, white-tailed deer, ruffed grouse, squirrels, and other small mammals, blue jays, rose-breasted grosbeak, and wood duck among other birds. The mature deciduous trees in these forests offer nesting sites for scarlet tanager, Baltimore oriole, and wood thrush, which are three species of conservation concern in this region. All three prefer deciduous or mixed mature forests. The oriole occurs in more open or semi-open wooded areas, while the wood thrush is found more commonly in mature forests with a denser understory of shrubs and sub-canopy trees. The scarlet tanager occurs across a broader range of mature forest understory conditions.

Bat surveys on the refuge from 2009 to 2011 detected several species of bats using the refuge both during migration and breeding period. Migrating species including northern myotis, eastern small-footed bat, little brown bat, big brown bat, and eastern red bat. Confirmed breeding species include northern myotis (most abundant), red bat, eastern small-footed bat, and big brown bat. Bats use forested areas for roosting and wetland areas for feeding. The loose bark of hickory species and other tree species in stages of decay provide breeding and migratory habitat for bats. The northern myotis and the big brown bat roost under tree bark and the red bat roosts in dead leaves in trees. Small-footed bats are found in rocky outcrops. Very little is known about the range, habitat, reproduction, and population size of bats in New England. In addition, recent dramatic declines in bats due to the white-nose syndrome raise the importance of Great Bay Refuge as potential habitat for breeding and migrating bats (see Shrub section for bat hibernacula and refugia at Great Bay). The Service is currently conducting a 90-day review for the listing of the northern myotis and eastern small-footed bat. To date, none of the bats caught at Great Bay has shown any signs of white-nose syndrome or wing damage. Much of New Hampshire's Appalachian oak forest is lost to development and large intact stands are rare. The remaining oak-hickory forests have fewer large trees, less diverse understory vegetation, and little coarse woody material on the forest floor.



In the summer and fall of 2006, the Forest Service, Forest Health Protection Group, Durham Office, conducted a forest health assessment on the refuge. Their full report is included as appendix H. In general, the forest stands on the refuge are healthy. However, many stands inventoried were overstocked, large diameter stands. This forest condition is common in stands that have had no active management. In their assessment, the distribution of size classes is not balanced on the refuge and mature size classes are overrepresented. They report that there is a potential for overstocked stands to be less vigorous, more susceptible to pests, lacking adequate regeneration in the understory, and which may lead to the loss of moderate to intolerant shade species in future stands. Their report includes management recommendations. As indicated below under our strategies, we will continue to work with the Forest Service and other forest ecologists to develop specific treatments for managing the refuge's forests.

The 41-acre increase in the Appalachian oak-hickory forest habitat is based on our proposal to allow small (less than 3 acres each) isolated patches of grassland and shrubland habitat, that are otherwise surrounded by trees and not providing quality grassland or shrubland habitat, to naturally revert to mature forest. This is expected to take at least 50 years. Over the next 15 years, however, we anticipate that those grassland patches will only transition to a shrubland-type and existing shrubland will only transition to a sapling-pole stand. Allowing these isolated patches to revert to forest over the long term will reduce edge effect from forest fragmentation, increase habitat for forest interior dwelling species of conservation concern, and reduce the amount of management-intensive habitat on the refuge.

### Strategies

*Continue to:*

- Assess use of refuge's habitats by Indiana bats, eastern small-footed bats, northern myotis, red bats, and other tree bat species using acoustic monitoring and mist nets, and monitor refuge's population for white-nosed syndrome; focus assessment on large diameter trees which may be important summer roosting habitat.
- Complete a vegetation map for Fabyan Point and Thomas property and update the natural community map for the rest of the refuge.

*Within 5 years of CCP approval:*

- Allow an additional 41 acres of grassland and shrubland habitat to naturally transition to forest (705 total acres) by discontinuing mowing.
- Work with forest ecologists to determine appropriate management techniques to sustain species diversity, forest structure, and ecological integrity of the oak-hickory forest community, and develop best management practices (e.g., prescribed fire, silvicultural practices, or passive management) to sustain a healthy oak-pine forest.
- Evaluate and develop management strategies for red pine, which occurs in 44 patches on 25 acres on the refuge. These pines are approximately 170 years old. According to Spurduto (2010 personal communication) red pine start to die out between 170 to 200 years old and may need fire to regenerate, although no evidence of fire is apparent on these sites and they appear to be regenerating naturally.
- Survey for and locate potential roosting sites for bats species known to breed on the refuge (northern myotis, red bat, big brown bat, and eastern small-footed bat) using acoustic monitoring and radio tracking.

- Manage 25 acres of plantations (white pine, red pine, white fir, and white spruce) to ensure succession to oak-hickory forests and control any disease outbreaks.
- Complete inventory and mapping of invasive plants for the refuge.

#### **Monitoring Components**

- Revisit the exemplary Appalachian oak-hickory forests identified by NHB in 1990 to assess their condition. Consult with NHB on this reevaluation. Evaluate the rest of the oak-hickory forest with these sites as reference.
- Monitor the red pine plantation by Woodman Point for successful regeneration, and manage (using prescribed fire) if necessary.
- Develop a long-term monitoring program to track the vegetative and wildlife response to climate change. Project topics may include phenology of plants and birds, species composition, hydroperiods of forested wetlands, and fire regimes.
- Survey forests and adjacent habitats for Indiana bats and other bats species. Use mist-netting and acoustic surveys during breeding, roosting, and migration periods to determine the presence and abundance of bat species. Also, search large diameter trees for bat activity, particularly in summer.
- Continue to partner with the Forest Service Research Station in Durham, New Hampshire, to conduct forest health surveys on a regular basis.
- Annually, monitor the long-term effectiveness of invasive plant treatments.

#### **Objective 2.2 Forested and Scrub-Shrub Wetlands**

Maintain the biological integrity, diversity, and environmental health of 158 acres of forested and scrub-shrub wetlands within the larger matrix of oak-hickory forests and Peverly Brook drainage, to sustain high water quality and native vegetation such as speckled alder, spicebush, silky dogwood, and winterberry, to benefit foraging woodcock, breeding willow flycatcher, other birds of conservation concern, and native plant communities. Ensure less than 10 percent of total vegetative cover of invasive plant species. Also manage wet forests and shrublands that contain functioning vernal pools to benefit vernal pool obligate species of conservation concern, such as wood frog.

#### **Discussion and Rationale**

We detail how we determined what elements comprise the biological integrity, diversity, and environmental health for each of the refuge's plant communities in appendix B (part 1.3). In summary, we reviewed historical conditions, site capability, the current regional landscape conditions, and the biological diversity on the refuge. We also considered natural processes and limiting factors which could potentially affect each plant community.

Approximately 13.5 percent of the Great Bay Refuge is forested or scrub-shrub wetland. As noted in chapter 3, approximately 81 percent of those wetlands are forested and 19 percent is scrub-shrublands. Vernal pools are an important habitat feature that is imbedded in these wetlands types.

In 2000, NHB mapped the following rare natural plant communities on the refuge. They identified four forested wetland community types:

1. Black gum–red maple–basin swamp
2. Seasonally saturated red maple swamp
3. Red maple–elm–ladyfern silt forest
4. Red maple–sensitive fern–tussock sedge basin/seepage

These forested wetlands are scattered throughout the refuge's forest and occur in a range of sizes from 0.27 acres to a 65-acre red maple swamp that is hydrologically connected to Stubbs Pond.

NHB mapped a mosaic of scrub-shrub habitats, including approximately 12 acres of "speckled alder basin/seepage shrub thicket." The moist, silty soils associated with this wet shrub community are particularly suited to alder thickets and hence potential foraging habitat for American woodcock. Moist shrublands are also habitat for several species of concern including willow flycatcher and blue-winged warbler, as well as many other migrating songbirds. Maintaining shrubland habitats in native shrub condition and controlling invasive shrubs requires active management.

Vernal pools are a critical component of these wetlands habitats because they support a wide diversity of species and are essential breeding habitat for some species of amphibians and invertebrates. Black gum basin swamps and other seepages can also function as vernal pools. Wood frogs, spotted and blue-spotted salamanders, and fairy shrimp all depend on vernal pools. Several rare species including Blanding's and spotted turtles also use vernal pools as "stepping stones" as they move from one wetland to another.

A former refuge manager created a 1-acre wetland in 1995 by installing a wooden water control structure to impound several drainage ditches in the former Weapons Storage Area. This wetland holds water during the spring and early summer and goes dry during late summer. Cattails dominate this wetland and a few marshbirds were noted here, such as sora and Virginia rails, and some frogs. We plan to remove the water control structure and plug the ditches to create a wet shrub-meadow to benefit New England cottontail and several bird species of concern, as mentioned above. There is another 1-acre impounded wetland east of Stubbs Pond and adjacent to the large red maple swamp complex. This open water impoundment was likely created with the collapse of a culvert under the access road to Stubbs Pond.

The amount of forested and scrub-shrub wetlands will increase approximately 9 acres from current levels due to the removal of the Lower Peverly Dam and restoration of a portion of Peverly Brook.

### Strategies

*Continue to:*

- Complete the inventory and mapping of invasive plant species. Prioritize invasive species to be controlled and implement control using biological, ecological or cultural, mechanical, prescribed fire, or chemical, as needed.

*Within 5 years of CCP approval:*

- Maintain water control structure off Ferry Way Trail to prevent flooding by beaver.
- Inventory, map, and assess the quality of forested and scrub-shrub wetlands, including vernal pool habitat, rare plants, and rare natural communities. Identify actions that will sustain or enhance these areas, including treating invasive plants, as warranted.
- Remove the water control structure from the 1-acre impoundment in the former Weapons Storage Area and plug the ditches to create wet shrub meadow habitat.
- If the access road to Stubbs Pond is rehabilitated, install a culvert where the current impoundment is to restore hydrological flow on both sides of the road.

### **Monitoring Components**

- Initiate a cover board project to inventory and monitor use of various habitats by salamanders and snakes. This project will measure presence, abundance, and habitat use by these species.
- Evaluate the existing amphibian and reptile monitoring data, including the deformed frog surveys, to determine other future monitoring needs.
- Continue participation in the U.S. Geological Survey's Amphibian Research and Monitoring Initiative (ARMI) to monitor long-term population trends of vernal pool associated amphibians and for water quality.
- Establish a monitoring program to measure vegetation and hydrology before and after removal of the water control structure in former Weapons Storage Area and near Stubbs Pond.
- Establish a monitoring program to evaluate the long-term effectiveness of invasive plant control.

### **Objective 2.3 Upland Shrubland**

Annually manage at least 54 acres of upland shrub habitat in three areas (former Weapons Storage Area, along McIntyre Road, and in the old orchard) to support native shrubs and young trees (e.g., highbush blueberry, black huckleberry, dogwoods, arrowwood, bayberry, meadowsweet, raspberry, sensitive fern, sumac, and elderberry) and less than 25 percent cover of invasive plants, to provide nesting and foraging habitat for migratory birds of conservation concern including prairie warbler, blue-winged warbler, eastern towhee, American woodcock, and New England cottontail and other thicket-dependent species.

- Within 5 years of CCP approval, evaluate the feasibility of establishing a captive breeding and/or "hardening" pre-release site for New England cottontail on at least 37 acres of shrubland in the former Weapons Storage Area. If determined feasible, manage these shrublands to provide preferred cottontail habitat which consists of dense native shrubs and vine tangles with a density of 20,000 woody stems per acre that are at least 20 inches tall and less than 3 inches in diameter. Work with partners to release captive bred young to suitable sites to reestablish or augment populations.
- Within 5 years of CCP approval, experiment with modifying two to four bunkers, which lie within shrubland habitat, to provide bat hibernacula and refugia. Work with the Service's NEFO and partners to explore those opportunities.

### **Discussion and Rationale**

The refuge currently has approximately 26 acres of early successional shrub habitat that is reverting from prior management as grassland or shrubland. We plan to manage an additional 28 acres of shrubland habitat to benefit migratory birds and other shrubland-dependent species of conservation concern. This additional acreage is primarily a result of active shrub management that will occur in the former Weapons Storage Area, which is currently grassland. Invasive species often quickly invade areas that are disturbed on the refuge, particularly grassland and shrubland areas. Autumn olive is particularly difficult to control as it quickly invades open land habitat. The shrub habitat provides nesting and foraging habitat for birds of conservation concern including prairie warbler, blue-winged warbler, eastern towhee, and American woodcock, and habitat for other thicket-dependent species. However, invasive plants also provide dense cover from predators needed by many of these species, particularly New England cottontail. When managing shrublands for birds and New England



cottontail, we will balance managing for a native composition of shrubs while providing sufficient cover and food resources. This is particularly true for New England cottontail habitat in the former Weapons Storage Area, where some areas will initially be allowed to be revegetated by invasives while we restore a more native, higher nutritional shrub cover in other areas.

Shrublands and brushy old fields are critical wildlife habitats that are essential for the survival of many wildlife species. Of the 40 bird species associated with shrubland habitats in eastern North America, 22 are undergoing significant population declines. Forest interior birds also use shrub habitats extensively during the migratory and post breeding period (Rodewald and Brittingham 2004, Vitz and Rodewald 2006, and Chandler 2007). Important habitat characteristics for both shrubland-dependent nesting birds and migrating birds include:

- High dense cover, which provides protection from ground and aerial predators.
- Native fruit-bearing plants; which provide diverse high quality prey base (Vitz and Rodewald 2004).

Additionally, 139 species of reptiles, amphibians, birds, and mammals either prefer (17 species) or use (122 species) shrub and old-field habitats. Shrubland habitats in the Northeast also contain higher proportions of State-listed butterflies and moths than other natural community types. Of 3,500 species of butterflies and moths in the Northeast, 58 are dependent upon shrublands, which provide sunny open areas in combination with desired host plants, such as scrub oak and blueberry. Fifty-six of these are considered rare (Tefft 2006).

Great Bay Refuge supports breeding habitat for several species of shrubland birds, including eastern towhee, prairie warbler, blue-winged warbler, and willow flycatcher. Shrub habitats on the refuge range from alder thickets (described under objective 2.2) to dry, old field conditions. In addition to its value to breeding birds, shrubland habitat is important because many other birds rely on it at various other times of the year. Many shrub species bear fruit in the fall, which helps boost the fat reserves for migrating and overwintering birds. Chandler et al. (2007) found that forest nesting birds preferred shrub habitat during the post-fledgling period, presumably due to its higher insect and fruit abundance. The loss and degradation of naturally maintained shrublands has been extensive throughout the region (Dettmers 2003). In Eastern North America over the last 60 years, open habitats (e.g., grasslands, savannah, barrens, and shrublands) have declined by 98 percent, with shrubland communities comprising 24 percent of this decline (Tefft 2006). Residential development, conversion to other land uses, and natural succession has contributed to the decline of shrub habitats. In southeastern New Hampshire, many shrub communities are now dominated by invasive plants.

The New England cottontail is a candidate species for listing under the Federal Endangered Species Act, and has declined significantly throughout its range. Litvaitis and Tash (2006) estimated the species only occupied 14 percent of its historical range as of 2004, with the population in New Hampshire and Maine persisting in highly developed, fragmented areas. Kovach and Fenderson (2010) found four major genetically distinct subpopulations:

- Maine/New Hampshire
- Cape Cod
- Connecticut/Rhode Island
- Connecticut/New York

All subpopulations face reduced fitness due to habitat fragmentation, with the Maine/New Hampshire and Cape Cod population at the greatest risk of extirpation. A fine-scale genetic study in southern Maine found a drastic reduction in patch occupancy and range contraction from 1997 to 2007, and a 50 percent reduction in effective population size of some remnant populations in the same time period (Kovach and Fenderson 2010).

Strong partnerships are developing in the cottontail rabbit's remaining ranges to manage and restore shrub habitat. However, major barriers to dispersal and rapid loss of genetic diversity and extirpation of local patches indicate that reintroduction and augmentation within each genetically distinct population is a necessary tool for the survival of this species. There is an ongoing effort at the Roger William Zoo in Rhode Island to captively breed and rear New England cottontail. To date, seven rabbits have been taken into captivity from Connecticut. Due to the necessity to maintain genetic separation among the four distinct populations, the zoo does not have the capacity to supply rabbits throughout its range.

We have been in discussion with partners regarding the potential for managing a captive rearing facility in the bunker area of the former Weapons Storage Area. This would increase the amount of shrub habitat that currently occurs on the refuge by approximately 30 acres. The former Weapons Storage Area is currently fenced, which would facilitate cottontail management. A captive rearing program on the refuge would be similar to that implemented for the riparian brush rabbit in the San Joaquin Valley of California, where founder rabbits are rotated through the facility at 6 to 12 month intervals, and then placed in the wild. We will also consider using the area for "hardening," a process in which captively breed rabbits are slowly acclimated to natural conditions prior to being released into the wild.

The refuge does not currently have sufficient shrub habitat to support a viable population of New England cottontail, even over the short term. However, we are exploring the option of working with partners to coordinate the protection of a significant population off-refuge in the Dover, New Hampshire, area.

The majority of bat species are facing unprecedented threats to their population due to white-nose syndrome. The disease was first detected in a cave in New York in 2007. Since then, it has spread to 13 U.S. states and 2 Canadian provinces, from ranging from Newfoundland, West Virginia to Indiana. In 2011, it was also detected in three additional states (Oklahoma, Delaware, and Missouri), however no deaths associated with white-nosed syndrome has been detected in those states to date.

Researchers suspect that a cold-loving fungus (*Geomyces destructans*) is cause of the disease. The fungus appears to disrupt normal patterns of hibernation, causing bats to arouse too frequently from torpor and starve to death. Staggering mortality rates (greater 90 percent in some caves) have pushed even some of the most common species to risk of extinction. Frick et al. (2010) predicted that little brown bats could be extinct in 20 to 60 years. The Service is currently reviewing the northern myotis and eastern small-footed bat for Federal listing (75 FR 38095).

In response to this threat, the refuge is collaborating with numerous partners, including the Service's NEFO, NHFG, and other states and refuges, to conduct a pilot study to adaptively modify two to four bunkers on the refuge to provide suitable hibernacula for bats. The pilot study involves monitoring temperature and relative humidity in the bunkers while we increase insulation and humidity in the bunkers using a wide range of techniques. Bats use military bunkers at

other sites in New England, including those at Odion State Park in Rye, New Hampshire. By modifying additional abandoned military bunkers to suitable hibernacula, we can:

- Provide alternative refugia/hibernacula to surviving bats or non-affected bats.
- Minimize spread of disease by disinfecting hibernacula after bats leave.
- Use bunkers as experimental chambers to eradicate white-nose syndrome or lessen its impact on infected bats.

Bat species that might use these bunkers include big brown bats, little brown bats, northern myotis, and eastern small-footed bat. All species of these are known to occur on Great Bay Refuge during the breeding and migratory season. Northern myotis are the most common species on the refuge.

Another benefit of shrub management is to conceal the existing bunkers. These bunkers are an eyesore in an otherwise natural landscape and cannot be reasonably removed without extensive disturbance and expense.

There are two other shrubland units on the refuge. The first is the 14-acre unit by MacIntyre Road that has sandy soils and supports primarily shrub species. This site could potentially support the State-listed endangered northern blazing star and the State-listed threatened hairy hudsonia. Both plants occur on abutting airport lands. Although these species do not currently occur on the refuge, this is a potential site for reintroduction. The blazing star occurs in sandplain grasslands and other dry, open habitats and may require prescribed fire. The hairy hudsonia also requires sandy areas. The other shrub unit is an old 3-acre orchard directly west of the MacIntyre Road unit. It will continue to be managed as an open orchard for wildlife observation.

Under this plan, as noted above, the overall shrubland habitat acreage on the refuge will increase by at least 28 acres due to active management in the former Weapons Storage Area on areas which are currently in grassland. However, it is also important to note that a few smaller shrubland habitat patches will transition to forest. These patches, each less than 3 acres, are either embedded in, or immediately adjacent to, large forest patches. Because they fragment the existing forest, and/or create additional edge habitat when contiguous forest habitat is a priority on the refuge; they do not provide valuable wildlife viewing opportunities; and, they are not efficient to manage from an administrative perspective, we plan to allow them to transition to forest. Management activities will be minimal in those shrublands, and likely only need to occur to manage invasive plants or pests.

Under Objective 2.1, "Appalachian Oak-Hickory Forests," our long-term plan is to allow small, disjunct patches of grassland and shrubland across the refuge to naturally transition to forest to minimize forest fragmentation and reduce edge effects. However, over the first 5 years of CCP implementation, we will evaluate wildlife use and response in those fields as the vegetation changes. If we find that regionally important shrubland-dependent species of conservation concern are using these areas we will consider actively managing them as shrublands, rather than allowing them to continue to transition to forest.

We may allow an additional 37 acres of grasslands in the former Weapons Storage Area to revert to shrubland if:

- Upland sandpipers do not breed in this field within 3 to 5 years.

- No other grassland species of conservation concern will benefit from those grasslands.

We will also continue to manage some of the former Weapons Storage Area as grassland for wildlife-observation opportunities and administrative purposes (see objective 2.4).

The shrub management areas are depicted on map 4.1.

### Strategies

*Continue to:*

- Complete the inventory and mapping of invasive plant species. Treat invasive plant populations using early detection rapid response methods. Prioritize invasive species to be controlled and implement control using biological, ecological, mechanical, or chemical methods, as needed.
- Maintain the existing shrub habitats using mechanical tools, such as a brush hog or mower.

*Within 5 years of CCP approval:*

- Use adaptive management to modify two to four bunkers to achieve ideal hibernation conditions for cave-dwelling bats (constant temperature above freezing and relative humidity of 80 to 100 percent from late August to May). Potential strategies include the following:
  - ✱ Close and insulate the door of the bunkers.
  - ✱ Scrape soil on top of bunkers and adding rigid insulation.
  - ✱ Plug drainage ditches and add water (small pools or water pumps) to increase moisture in bunkers.
  - ✱ Install bricks and cinder block walls for added thermal regulation and hibernating surfaces.
- Determine what ecological integrity components should be monitored as part of the managed shrub community and develop a management plan that will sustain the 54 acres on an approximately 15-year rotation.
- Establish partnership with scientists at Boston University to identify and conduct various research projects involving bats and bat ecology.
- Develop a restoration and monitoring plan for the bunker areas at the south end of the former Weapons Storage Area and the areas abutting this site (outside the fenced former Weapons Storage Area) as a shrub community totaling approximately 37 acres or more, using a “brontosaurus” or other mechanical tools, and native plantings as needed. Incorporate monitoring protocols and adaptive management techniques gained from the Regional Shrub Adaptive Management Project led by the Parker River Refuge biologist.
- Collaborate with NHFG and UNH to determine feasibility of starting a New England cottontail captive propagation on the refuge for reintroduction to other areas in the region.
  - ✱ If found feasible, maintain the existing Weapons Storage Area fence around the proposed native shrub management area to provide safe habitat (free of mammalian predators) for New England cottontails. Shift rest of fence to create enclosure at north end of shrub management area.



- If right conditions achieved for hibernating bats, work with partners to develop a plan to attract bats and manage and/or experiment with different ways to address white-nose syndrome.
- Develop a shrub restoration partnership to propagate native species and work with local contractors to select and transfer dominant shrubs from development sites.
- Determine the distribution and management needs of northern blazing star and hairy hudsonia, and evaluate potential habitat for reintroduction of northern blazing star. If potential habitat is located and reintroductions are possible, develop survey and monitoring protocol for reintroduced populations.
- Evaluate upland sandpiper use in the managed grassland portion of the former Weapons Storage Area. If upland sandpipers do not nest here within 3 years of creating suitable habitat, let the majority of grassland (30 to 35 acres) revert to shrub habitat.
- Evaluate wildlife use and response in the 41 acres of grassland and shrubland we are allowing to naturally transition to forest (see objective 2.1). If these areas are providing regionally important habitat to shrubland-dependent species of conservation concern, evaluate whether the resources are available to actively manage these areas as shrubland, and adjust management accordingly, rather than allowing them to continue to transition to forest.

#### **Monitoring Components**

- Establish a monitoring program to evaluate the long-term effectiveness of invasive plant control treatments.
- Monitor the density and plant composition in the shrub habitat blocks every 5 years to assess management needs.
- Monitor breeding and migratory bird use of shrub habitat after successful establishment and every 5 years as part of breeding bird point surveys. Data collected will include presence/absence and abundance.
- Monitor for other shrub-dependent species, such as black racer and smooth green snake, using the cover board technique or other established protocols.
- Monitor modified bunkers to obtain suitable conditions for hibernating bats (temperature and relative humidity on an hourly to daily basis). If ideal conditions are established, work with partners to continue to monitor conditions and develop an additional strategy for monitoring strategy bat use in the bunkers. Within 2 years of achieving ideal conditions, work with partners to establish a plan for ongoing research on hibernating bats in bunkers.

#### **Objective 2.4 Grassland**

Annually manage the Thomas Field (39 acres) to maintain a mix of grass and herbaceous vegetation at mixed heights ranging from 8 to 24 inches during the summer, with minimal thatch build-up, less than 15 percent of total vegetation of woody species and greater than 5 percent bare ground, to provide nesting habitat for upland sandpiper and other grassland species of conservation concern.

Annually manage the former Weapons Storage Area (38 acres) similar to the Thomas Field. If upland sandpipers do not breed in this field within 3 to 5 years, and no other grassland species of conservation concern would benefit from those grasslands, determine whether to allow the Weapons Storage Area Field to revert to shrubland. Include in that determination whether to maintain a small

portion of grassland in the northwest corner for wildlife observation and cultural interpretation.

Manage the Woodman Point Field (15 acres) to maintain a mix of grassland herbaceous species as nesting habitat for bobolinks, singing habitat for woodcock, and migration habitat for Lepidoptera and other species of conservation concern. Manage the Ferry Way Trail grassland unit (6 acres) primarily to provide habitat diversity for wildlife viewing along the trail and also to support singing habitat for woodcock and migration habitat for Lepidoptera and other species of conservation concern.

### **Discussion and Rationale**

In 2005, refuge staff were managing 21 treatment areas as grasslands for nesting birds and other wildlife, primarily in the former Weapons Storage Area, at Woodman Point, along the refuge road, along Ferry Way Trail, and adjacent to the Thomas Farm. Many of these grassland areas have a component of little bluestem, as well as nonnative grasses. The largest grassland, approximately 70 acres, is in the former Weapons Storage Area. This grassland complex is managed using prescribed fire and mowing to control autumn olive and other woody plants. The 30-acre Thomas field and 24-acre Woodman Point Field complex are mowed and hydro-axed. The remaining grassy areas range from 2 to 4 acres in size and are mowed every 1 to 2 years to benefit woodcock. Since 2008, seven of these treatment areas have been allowed to revert to shrub or forest habitats.

Northeastern grasslands have provided habitat for grassland birds and other wildlife for hundreds of years. Historically, most of northern New England was forested with grasslands generally restricted to scattered small openings along river floodplains, wetlands, and beaver meadows. However in southern New England early settlers described more extensive openings including coastal sandplain grasslands, heathlands, and openings maintained by Native Americans. By the 1800s, grasslands were widespread throughout the region and grassland birds such as grasshopper, savannah, and vesper sparrows, upland sandpipers, eastern meadowlarks, and bobolinks were thought to be prevalent. By the late 1800s grasslands were declining as farms were abandoned, existing farms changed their use of the land, and fire was used less. More recent human development has consumed many remaining open fields. Remnant patches of grasses remain throughout the Northeast along railroad grades, rivers, roadsides, cemeteries, pastures, old fields, and reverting farmlands (Capel 2006).

Grassland bird species recorded during surveys on the refuge from 2001 to 2003 included eastern meadowlark, bobolink, upland sandpiper, field sparrow, red-winged blackbird, American kestrel, and vesper sparrow. Brown thrasher and eastern towhee, two shrubland species, were also recorded. In 2003 and 2004, at least one pair of upland sandpipers was observed using the former Weapons Storage Area and the Thomas field during the nesting season. The Thomas Field pair was observed nesting for the second year in a row.

In the NHWAP (NHFG 2005), “extensive grasslands” are defined as areas greater than 25 acres dominated by grasses, forbs, and sedges with little shrub or tree cover. Large grasslands are particularly important, since many grassland birds require large areas for nesting. The State-listed endangered upland sandpiper, for example, typically requires over 150 acres of grassland that supports a mix of short (greater than 8 inches) grasses for foraging and taller (up to 24 inches) grasses for nesting. They also need taller structures—fence posts, signs, tall mullein—as singing perches. Many of the remaining large

grasslands in New Hampshire are restricted to hayfields, cropland, airports, capped landfills, and military installations, places that do not have wildlife habitat as a primary objective and in some cases may be in conflict with wildlife management (NHFG 2005). The airfield at the Tradeport, adjacent to the refuge, has supported a population of 8 to 12 nesting pairs of upland sandpipers on its 500 to 600 acres of grasslands since 1989. As this is the State's only extant breeding population, the Tradeport and NHFG seek help in managing a second population of upland sandpipers on refuge land. The species has been sighted at several other locations in New Hampshire including Dover, Manchester, and southern Coos County (P. Hunt and D. De Luca, New Hampshire Audubon 2011 personal communication with refuge manager).

Given the regional decline of grassland habitats, the refuge can play an important role in maintaining several large blocks of this habitat. Here, the Service has the capacity to annually manage these habitats to benefit species of conservation concern. The refuge has two sites that lend themselves to managing large blocks of grassland habitat: the north end of the former Weapons Storage Area and the Thomas Field at the south end of the refuge. Although both sites are smaller than the 150-acre minimal patch size, upland sandpipers have nested in both fields in the past, and are known to prefer grassland adjacent to airports (USGS 2006).

Two additional sites will also continue to be managed as grassland. The Ferry Way Trail grassland unit is 6 acres and will be managed to provide a popular and high-quality wildlife viewing opportunity for the public. The 15-acre Woodman Field includes a diverse mix of grasses and flowering herbaceous species.

Another potential area to consider for future grassland management is a 15 to 20 acre field on the northern boundary of the refuge, north of the Ferry Way Trail. A small little bluestem field has persisted there since prior to 2000 (mapped by NHB) without any management. Additionally, the soils adjacent to this small grassland, including the 15-acre pine plantation, are very sandy and suitable for grassland management. Although these grasslands are not suitable for upland sandpipers, they may benefit other wildlife species, such as bobolink, northern leopard frog, smooth green snake, butterflies, moths, spiders, bees, and other insects (NHFG 2005).

Under this plan, grassland acres will be reduced from 169 acres to 98 acres. Of that 71 acre reduction, 28 acres of grassland will be actively managed as shrubland in the former Weapons Storage Area, thus continuing to provide early successional habitat. The remaining 43 acres will be allowed to revert to forest for to reduce forest fragmentation and edge effects. In summary, we will propose to allow fields to revert to forest if they meet at least one of the following criteria:

- They fragment the existing forest.
- Create additional edge habitat when contiguous forest habitat is a priority on the refuge.
- They do not provide valuable wildlife viewing opportunities.
- They are not efficient to manage from an administrative perspective.

Management activities will be minimal in the area allowed to revert to forest, and likely only need to occur to manage invasive plants or pests.

The grassland management areas are depicted on map 4.1.

### **Strategies**

#### *Within 2 years of CCP approval:*

- Complete the inventory and mapping of invasive plant species. Prioritize invasive species to be controlled and implement control using biological, ecological, mechanical, or chemical methods, as needed.
- In conjunction with revising the HMP, develop best management prescriptions (e.g., mowing, burning, frequency, seeding, haying, disking, etc.) for maintaining grass-dominated fields of variable sizes as indicated below.
- Enhance the habitat quality of the two larger grassland habitats (39-acre Thomas field and 38-acre former Weapons Storage Area field) for upland sandpipers through annual mowing, burning, and/or other management tools after grassland bird breeding season (August 1). Consider management options that will also benefit pollinators.
- Similarly, manage the Woodman Field (15 acres) as nesting habitat for bobolink, singing grounds for American woodcock, and as migration habitat for Lepidoptera.
- Evaluate site capacity (including soil and hydrology) of all non-administrative grassland units to determine ideal plant species composition and structure, use of management tools such as fire and mowing; and restore to shrub or forest if site is not suitable for grassland management. Evaluate site capacity of shrub unit by MacIntyre Road and the pine plantation by the refuge's northern boundary to be managed as grassland habitat for pollinators, bobolinks, and singing ground for American woodcock.
- Mow the 6 acres of fields along the Ferry Way Trail for early successional species such as pollinators, raptors, and landbirds as well as a wildlife viewing site for visitors.
- Allow eight patches of shrub and grassland openings in the forest to revert to forest to reduce forest fragmentation.
- Except as discussed elsewhere under historic resources, remove any remaining structures. Within the former Weapons Storage Area this will include all above ground structures and possibly some of the bunkers.
- Partner with New Hampshire Audubon and NHFG to develop methods for enhancing habitat for upland sandpipers on the refuge.

#### *Within 5 years of CCP approval:*

- Remove remaining Weapons Storage Area fencing and remaining military structures in the grassland management area. Remove hedgerows and small woodlots at the Thomas Field to enlarge the grassland area.

### **Monitoring Components**

- Continue to monitor breeding birds in the refuge's grassland habitats, according to regional protocol, to determine population trends, density, and use by grassland obligate species (e.g., upland sandpiper).
- Develop monitoring protocol and establish parameters to determine success for restoration of grassland habitat (for upland sandpipers) and for restoration of grasslands to shrub or forested habitat.



**GOAL 3.****Foster and maintain conservation, research, and management partnerships to promote protection and stewardship of the ecological resources of the Great Bay Estuary.****Objective 3.1 Great Bay Resource Conservation, Research, and Management Partnerships**

Maintain and expand current key partnerships to promote land conservation, stewardship, research, and management of resources of concern within the Great Bay Estuary. These partnerships include the Great Bay Resource Protection Partnership, Piscataqua Region Estuaries Program, Coastal Watershed Invasive Plant Partnership, Pease Development Authority Wildlife/Bird Strike Hazard Committee, and the New England Cottontail Working Group, among others.

**Discussion and Rationale**

GBRPP is a coalition of public and private conservation groups that formed in 1994 to help protect the remaining important habitats within and around Great Bay. GBRPP takes a comprehensive, landscape-scale approach to conservation and habitat protection by developing and implementing conservation strategies through a combination of scientific field studies and ongoing communication with local, regional, State, and national conservation representatives. Parker River Refuge's refuge manager attends the quarterly meetings of GBRPP. Since 1996, the partnership has protected over 5,000 acres of habitat around Great Bay.

In 1992, a MOA was signed between the Service, Federal Aviation Administration, U.S. Department of Agriculture–Animal and Plant Health Inspection Service), and Pease Development Authority. The MOA calls for coordination and quarterly meetings among the parties to review and discuss past and future wildlife management practices by the Service on the refuge and Pease Development Authority at the airport; the effects of such management practices on airport operations and on Service trust resources; and airport facility aircraft operations and their potential effects on the refuge (MOA 1992). This group is referred to as the Wildlife/Bird Air Strike Hazard Committee. Current issues include managing upland sandpipers that nest on the airport, impacts of large birds, such as wild turkeys, on the runway, and addressing potential impacts to the refuge from new de-icing pads and other sources of runoff.

As previously mentioned, Great Bay Refuge is a “sustaining partner” of CWIPP, a partnership among 11 agencies and organizations concerned with the effects of invasive plants within New Hampshire's coastal watershed. The goal through this cooperative effort is to achieve better management of invasive plants while improving working relationships between the signatories and the public.

We will also expand our partnerships to include the New England Cottontail Working Group, as well as partnerships with local land trusts and other private land management cooperatives in the region that have a goal to conserve lands of high resource value to Federal trust species.

**Strategies**

*Continue to:*

- Be an active member of GBRPP and serve on the Principal Partnership and Stewardship committees.
- Participate on the Pease Development Authority Wildlife/Bird Airstrike Hazard Committee.
- Serve on the PREP Management Committee.
- Participate in oil spill response training and coordination. One important reason to stay current on these skills is as a precaution in the unlikely event that an accident occurs with the shipping traffic up the Piscataqua River.

- Partner with the town of Newington, NHFG, and regional Service personnel on law enforcement on and around the refuge.
- Attend CWIPP meetings and actively participate in coordinated invasive control and outreach efforts.

*Within 2 years of CCP approval:*

- Facilitate research on the refuge, with focus on research that supports management goals and objectives, such as groundwater studies, hydrology, land use change impacts, habitat management, and habitat restoration. Identify refuge research needs and establish links with partners who can assist the refuge in researching these management questions; specifically, partner with the GBNERR and the National Estuarine Research Reserve's Science Collaborative.
- Work with the New England Cottontail Working Group to implement habitat improvements and opportunities for cottontail recovery. Evaluate the feasibility to propagate and restore New England cottontails to the refuge, specifically within the former Weapons Storage Area.
- Support research by partners in the Great Bay Estuary on conservation and management of eelgrass and oyster restoration, Great Bay water quality, and other topics that are linked to the refuge's goals and objectives.
- Work with Service's Ecological Services Private Lands Program to identify and evaluate projects that will support or enhance refuge goals and objectives on other ownerships in the area and provide other resource assistance when possible.

*Within 5 years of CCP approval:*

- Enhance and strengthen collaboration with UNH's Jackson Lab in research and restoration of the Great Bay Ecosystem, particularly with restoration of eelgrass and oyster beds, salt marsh research, and monitoring water quality in the bay.
- Work with partners around Great Bay to create habitat management demonstration areas on the refuge and partner lands, including demonstration of invasive species control, grassland and shrubland management, dam removals, and oyster bed restoration. Facilitate technical workshops pertaining to the demonstration areas.
- Become a signatory to the CWIPP agreement.

*Within 10 years of CCP approval:*

- Establish partnership with Pease and Great Bay Country Clubs to develop management plans for their lands that contributes to the goals and objectives of the refuge and local conservation partnerships.

**Monitoring Component**

- The Air Force will continue its long-term groundwater well monitoring on the refuge to monitor water quality impacts from previous military uses. Obtain and interpret the results of this monitoring relative to refuge management. Adapt management practices accordingly.
- Develop a long-term monitoring plan to help identify and remediate (as feasible and necessary) potential offsite source of pollution that could negatively impact the refuge.

### Objective 3.2 Landscape-scale Conservation Partnerships

Over the next 15 years, expand partnerships to address the refuge's role in landscape-scale conservation issues including climate change, regional population trends, research priorities, land use changes, and water quality.

#### Discussion and Rationale

GBNERR is also a member of GBRPP and the boundary of the reserve encompasses Great Bay Refuge. The Research Reserve System recently established a science collaborative, to fund cooperative, science-based projects that address coastal management issues. The priority research areas include impacts of land use change, habitat change and restoration, estuarine contamination, and stormwater and nonpoint source pollution management. GBNERR is specifically interested in water quality, land use change, biological communities, and climate change. The Service is interested in collaborating with the reserve and other researchers on many of these issues.

In 1999, the Service launched the nationwide Land Management Research and Demonstration (LMRD) Areas "...to facilitate development, testing, teaching, publishing, and demonstration of state-of-the-art management techniques that support the critical habitat management information needs for fish, wildlife, and plant conservation within the System and other lands" (USFWS 1999). Two LMRD areas were established in our region: the Northern Forest LMRD and the Coastal Salt Marsh LMRD. Partnerships are a key element of demonstration areas. The Great Bay Refuge will partner with other participating national wildlife refuges, State and Federal agencies, universities, and others to further research on and off the refuge to advance our understanding of wildlife habitat concerns in the northern forest and coastal salt marshes.

The greatest effects of climate change will be on regional air and water temperatures, precipitation patterns, storm intensity, and sea levels. These effects are predicted to influence natural disturbances by resulting in an increase of freeze-free periods, decreased snow cover, increased storm intensities and frequencies, increased likelihood and frequency of droughts, damaging ozone, and an increase in the spread of invasive species and disease (NHFG 2005). The resulting effects on wildlife and habitats are expected to be variable and species-specific, with a predicted general trend of ranges shifting northward. The uncertainty about the future effects of climate change requires managers to use adaptive management to maintain healthy ecosystems in light of that unpredictability (Inkley et al. 2004). Tidal marshes are among the most susceptible ecosystems to climate change, especially rapid sea level rise. The refuge expects to partner at all levels—around Great Bay, within New Hampshire, regionally and nationally—to address this immense conservation challenge.

#### Strategies

*Within 5 years of CCP approval:*

- Conduct a research needs assessment for the refuge. Emphasize research projects that evaluate our assumptions, objectives, strategies, and techniques on species, habitat, and ecosystem management.
- Develop information exchange for research. Seek research partnerships to foster collaborations across the region.
- Collect information that contributes to regional information needs such as winter banding of waterfowl to help define populations.
- Identify the role of the refuge in contributing to the Service's 5-Year Action Plan on climate change and support similar initiatives in NHWAP and NHCP.

- Participate in and support the priorities of the North Atlantic LCC.
- Collaborate with GBNERR on monitoring sea level rise as part of national effort. Assess feasibility of having refuge install a sediment elevation table (SET) in the refuge salt marsh.
- Work with PREP to support the EPA climate ready estuary project; Work with GBNERR and Great Bay Stewards to develop and outreach impacts of human land use and climate change on the bay's resources, and facilitate implementation of mitigation measures by the bay's residents and visitors.
- Establish a partnership with UNH and the Jackson Lab to work with the refuge in addressing research needs.

#### **Monitoring Components**

- Continue to participate in regional ecological studies, such as malformed frog surveys, land bird monitoring, frog call surveys, analyses of mercury in fish, and invasive plant distribution surveys and control methods.
- Collaborate with the Service's Regional Inventory and Monitoring Program and our Great Bay partners to monitor long-term trends associated with climate change and effectiveness of mitigation measures.

#### **Objective 3.3 Education and Outreach Partnerships**

Within 5 years of CCP approval, support and coordinate with area environmental education facilities such as the Great Bay Discovery Center and the Seacoast Science Center, as well as area schools, to advance wildlife conservation and refuge goals.

#### **Discussion and Rationale**

Similar to many refuge programs, partnerships are key to the success of our environmental education and outreach programs. Specifically, refuge staff have partnered with the Youth Conservation Corps (YCC), Student Temporary Employment Program (STEP), Student Career Experience Program (SCEP), and the Phillips-Exeter Sustainable Program to complete projects on the refuge. The students gain valuable experience and the refuge completes much needed management activities.

By collaborating with and supporting area environmental centers, including local schools, the refuge can affect a wide range of environmental education opportunities. The Great Bay Discovery Center, on the shores of Great Bay in Greenland, serves as the conservation-education headquarters for GBNERR. Their facility offers interpretive displays, meeting space for workshops, outdoor interpretive trails, and reaches people of all ages with stewardship messages. Likewise, the Seacoast Science Center has many similar features. By working together on stewardship messages, and sharing resources where feasible, we can multiply our individual efforts into a more effective collective effort to promote environmental stewardship in coastal New Hampshire.

#### **Strategies**

*Continue to:*

- Partner with YCC program.
- Use the STEP and SCEP programs to mentor students and achieve refuge goals and objectives.
- Help CWIPP develop fact sheets on priority invasive species.



- Collaborate with Phillips-Exeter Academy students to complete refuge projects.

*Within 2 years of CCP approval:*

- Add a Web site link to GBNERR and other relevant links (such as Save Great Bay on Coastal Program Web site) on the Great Bay Refuge Web site.
- Work with the GBRPP to create regional recreational access information and maps that highlight locations around the bay where recreational activities can occur, especially those not available on the refuge such as kayak/canoe launch points.
- Collaborate with the Great Bay Discovery Center and GBRPP on educational and interpretive programs, materials, and maps; share outreach messages.
- With partners develop stewardship outreach material and program to reduce pollution and fertilizer runoff from residential and commercial facilities.
- Collaborate with local schools, GBNERR, and Gulf of Maine Institute (GOMI), to establish a coastal environmental stewardship and advocacy team with high school students in New Hampshire (see Newburyport, Massachusetts, high school team as example and other GOMI-sponsored team).
- Seek a volunteer willing to coordinate the volunteer program to improve organization, recruit new volunteers, and help prioritize and implement work.
- Create an orientation program for all volunteers and expand volunteer corps.
- Work with the Pease Development Authority and Great Bay Stewards to establish a Friends of Great Bay Refuge group.
- Partner with the New Hampshire Office of Tourism, New Hampshire Department of Transportation, Pease Development Authority, and others to provide information on the refuge, including signs, maps, and directions to the refuge.

#### **GOAL 4.**

**Promote enjoyment and awareness of the Great Bay Refuge and Great Bay Estuary by providing high-quality, compatible, wildlife-dependent public uses on refuge lands and on partner lands and waters around the refuge.**

##### **Objective 4.1 Wildlife Observation and Photography**

Provide enhanced high quality wildlife observation and photography opportunities by improving the refuge's two existing trails and pursuing new self-guided opportunities on Fabyan Point.

##### **Discussion and Rationale**

The Refuge Improvement Act of 1997 identified wildlife observation and photography as two priority public uses for national wildlife refuges, along with environmental education, interpretation, hunting, and fishing. In 2006, the Service's regional visitor services team identified wildlife observation and photography as areas of emphasis for Great Bay Refuge.

As an unstaffed refuge, we have had limited ability to conduct a vibrant visitor services program. Despite these limitations, the refuge is popular, especially for birders and walkers. The refuge is open from dawn to dusk, with vehicle access controlled by a timed gate along Arboretum Drive. The trails are for foot traffic only. The Peverly Pond Trail is wheelchair accessible. Bicycles and motor vehicles are limited to the entrance road and parking lot. Pets are only allowed in the

USFWS



*Great blue heron*

vehicle-accessible areas and only on leash. All other areas beyond the parking lot and the two trails are closed to the public.

The existing trails lead to several different habitat types including freshwater wetlands, fields, oak-hickory forests, and the shores of the Great Bay Estuary. They are accessed from the visitor parking lot at the end of Arboretum Drive, adjacent to the refuge office building (map 4.2). The 2-mile Ferry Way Trail begins across from the parking lot and starts out as an asphalt path next to a chain link fence (the former Weapons Storage Area). A leisurely walk on this trail takes about 2 hours. The 0.5-mile Peverly Pond Trail begins to the east of the parking lot.

Three Service staff conducted a visitor services review of the refuge in fall 2009. The review is part of the CCP planning process and provides recommendations to improve the quality of the visitor services at the refuge. Given the lack of staff and closure of the refuge office in recent years, many people are unaware of the visitor services opportunities available on the refuge. The recommendations included modest improvements to the existing trails and interpretive materials and structures to enhance the existing wildlife viewing and photography experience at the refuge, as well as attract more visitors. This in turn offers an opportunity to reach more people with key stewardship messages.

### **Strategies**

#### *Continue to:*

- Pursue funding to construct a boardwalk along the entire Peverly Pond Trail to meet accessibility standards.
- Maintain the view from the Ferry Way Trail observation deck by pruning shrubs and brush that grow in over time.

#### *Within 3 years of CCP approval:*

- Reroute the Peverly Pond Trail and modify Ferry Way Trail to improve wildlife viewing opportunities.
- Add benches and an interpretive sign to the wildlife observation blind.
- Highlight wildlife observation and photography opportunities on the Great Bay Refuge Web site.
- Improve trail sign location, including installing “No Dogs” and “No Bicycles” signs at trailheads.
- Construct an elevated observation platform overlooking the former Weapons Storage Area with interpretive panel, once the former Weapons Storage Area fencing and structures are removed.
- Remove roads around buildings in the former Weapons Storage Area once buildings are demolished.
- Develop a bird or watchable wildlife checklist for the refuge.
- Create a hotspot for the refuge on eBird and encourage visitors to post their sightings. Include a link to eBird on the refuge’s Web site.
- Conduct a refuge photo contest during June through August. Check with local businesses for potential prize donations.

- Work with area biking enthusiasts to develop a bike access onto McIntyre Road at juncture with the refuge entrance road underpass.
- Develop a more effective method for gathering visitor services data (e.g., number of daily visitors, visitor uses, and experiences at refuge).

*Within 10 years of CCP approval:*

- At Fabyan Point, pursue acquisition of public access right-of-way and upgrade road conditions to allow safe passage of public vehicles.

■ *Within 15 years of CCP approval:*

- If the public access right-of-way at Fabyan Point is acquired, we will use a staged approach to upgrading and constructing facilities there. If feasible, there are no safety concerns, and there are no anticipated negative impacts to wildlife, we will:

- ✱ First, make minor improvements to the road, create several parking places, and build an interpretive kiosk.
- ✱ Second, construct a trail and viewing platform.
- ✱ Finally, construct a car top-only boat launch.

#### **Objective 4.2 Environmental Education and Interpretation**

Within 5 years of CCP approval, 90 percent of refuge visitors contacted will be able to identify the refuge's purpose, name at least one habitat and associated wildlife species of conservation concern, or know the regional importance of the refuge through their experiences at the refuge or with one of our partners around Great Bay.

#### **Discussion and Rationale**

Great Bay Refuge is close to a highly populated area. Yet, due to the lack of staff, closed office, and history as a former military base, many members of the local community do not realize that the refuge is open to the public. Yet, the refuge has many unique natural resources and a diverse cultural history to share with visitors. The absence of dedicated visitor services staff for the refuge has resulted in few public interpretive programs or environmental education on or off the refuge. The refuge currently relies on volunteers to lead walks or other interpretive programs, which depends solely on their interest and availability. We continue to receive more requests for these types of programs than we can currently fill. Right now, our major interpretive materials consist of a general station brochure and one kiosk that provide information on the refuge, wildlife, and refuge management.

The refuge Web site also lacks information or links for teachers or students. Census estimates for 2008 indicate that 139,546 persons under 18 years old live in the three counties closest to the refuge: Rockingham and Strafford Counties in New Hampshire and York County in Maine. There is a tremendous opportunity for the refuge to help with environmental education in the area and to increase the appreciation and stewardship of the refuge through greater interpretation.

#### **Strategies**

*Continue to:*

- Provide limited environmental education and interpretation programs upon request.
- Use volunteers, if available and interested, to conduct occasional guided walks along existing trails.

*Within 2 years of CCP approval:*

- Update exhibits and information panels and refuge Web site; improve visitor orientation.
- Set up a wildlife observation log book and a visitor register at the main kiosk.
- Reroute the Peverly Pond Trail and modify Ferry Way Trail to improve wildlife viewing opportunities. Once the former Weapons Storage Area fence is removed, shift the Ferry Way Trail as appropriate.
- Initiate guided interpretive walks that can be led by partners and volunteers.
- Investigate opportunities to engage more youth programs on the refuge and on partner lands.
- Investigate opportunities to expand relationship with faculty and student programs at Phillips-Exeter to expand research projects.

*Within 5 years of CCP approval:*

- Develop three to five key environmental education messages, and activities associated with each message, about the refuge flora, fauna, habitats, and ecosystems that can be used in environmental education programs with local school teachers, college faculty, and youth group leaders.
- Develop key interpretive themes and the major messages to convey about the refuge, its role in regional conservation, and how citizens can become better stewards of the environment. Use these themes and messages to update the interpretive panels at main kiosk at parking lot.
- Collaborate with GBNERR to create shared stewardship messages and interpretive materials.
- Develop curriculum-based, multi-sensory, interdisciplinary, and learner-based environmental education activities that can be lead by volunteers. Partner with others such as UNH Cooperative Extension Coverts Project, UNH Marine Docents, Seacoast Science Center, Great Bay Discovery Center, and others.
- Develop interpretive materials to highlight the prehistoric and historic land use history of the Great Bay area and the rich cultural history of refuge lands, including the history of Pease Air Force Base and its relationship to the Cold War.
- Replace the current paved parking lot with a permeable surface. Consult with the UNH Stormwater Management Center to determine appropriate design and materials, and develop interpretive materials related to design.

**Objective 4.3 Hunting**

Continue to provide a quality hunt program to manage wildlife populations, protect habitat, and provide a priority, wildlife-dependent recreational opportunity.

**Discussion and Rationale**

Prior to Service ownership, deer and waterfowl hunting were permitted by the Air Force, but it was limited to military personnel, retirees, and their dependents, and was only allowed in certain areas. From 1967 to 1989, the Air Force used hunting as a management tool, due to the need to minimize aircraft strikes on the runway. It was estimated that 8 to 10 deer were taken annually from throughout the former Pease Air Force Base. The Air Force also permitted waterfowl hunting only on Stubbs Pond and only for Air Force personnel,



dependents, and retirees. The former base was closed to hunting from 1989 to 1993 in advance of the land transfer to the Service (USFWS 1995).

When the refuge was first proposed, the Service received public comments that a public deer hunting should continue, while others suggested that it be used only as a biological management tool. In response to these comments, a Hunt Plan was completed for the refuge in 1993 (USFWS 1993). In 1995, the Service completed an EA to evaluate establishing and conducting an annual, public white-tailed deer hunting program and waterfowl hunting program on the refuge. The decision from this EA was to open the refuge to controlled hunting of white-tailed deer in accordance with all Federal, State, and local regulations (USFWS 1995).

The first white-tailed deer hunt on the refuge occurred in the fall of 1996 and has been held every year since then. The hunt is a 2-day, Saturday and Sunday hunt, by fee permit only. A maximum of 20 permits per day are drawn from a pool of applicants each year. From 1996 to 2007 the number of hunters has ranged from 13 to 22. The number of deer harvested during a given hunt has ranged from 8 to 22 deer, with a mix of does and bucks taken. The refuge is closed to all other public uses during the 2-day deer hunt.

The refuge shoreline is open to waterfowl hunting under state seasons and regulations, with access by boat only. Land access for waterfowl hunting is not allowed on the refuge. Only occasionally are a few waterfowl hunters observed using the area.

Both Pease Airport Authority and NHFG support offering a wild turkey hunt on the refuge. First, offering a wild turkey hunt will provide a priority, wildlife-dependent recreational opportunity to refuge visitors. According to NHFG, there is an adequate population of wild turkeys at the refuge to support a hunt (Bridges 2011 personal communication). Second, Pease Airport Authority believes a hunt would help reduce the airport's turkey population. Currently, turkeys are the greatest hazard to airport operations (i.e. bird-air strike hazard). Although we do not have a specific proposal, we will evaluate whether to offer either a spring or fall turkey hunt, or both. During the State's spring turkey season, hunters are only allowed to harvest males (gobblers). However, hunters are allowed to harvest females during the fall season, which will likely better control the turkey population. We will also consider developing a youth turkey hunting program, in cooperation with NHFG and other partners, to extent practicable and there is interest.

### Strategies

*Continue to:*

- Provide a 2-day lottery deer hunt, with a maximum of 20 fee permits issued. Work with NHFG to handle the permit applications.
- Provide a waterfowl hunt according to 50CFR (Part 32, Subpart B, § 32.48), including limiting access to the refuge shoreline by boat only launched from areas outside the refuge.
- Maintain closure on recreational trapping on the refuge.

*Within 3 years of CCP approval:*

- Evaluate the opportunity to expand the hunt program to include a fall bow season for deer and a turkey season. Develop a youth turkey hunting program, in cooperation with NHFG and other partners, to the extent practicable and there is interest. Pursue all administrative procedures necessary to pursue the expanded hunt opportunities, including NEPA and public involvement, as warranted.

- Work with NHFG to evaluate closing the shoreline of the refuge, including Herods Cove, to waterfowl hunting to protect estuarine habitats and associated species.

#### **Objective 4.4 Fishing**

Provide maps and other information about off-refuge fishing opportunities to refuge visitors and continue to assess the potential to open the refuge to fishing in the future by annually monitoring the level of contaminants in refuge sediments and fish, and assessing the potential health risks from consuming refuge fish.

##### **Discussion and Rationale**

Upper Peverly, Lower Peverly, and Stubbs Ponds were historically stocked and fished by the Air Force as we detailed in chapter 3 under “Freshwater Impoundments.” The two Peverly Ponds were stocked with largemouth bass, rainbow trout, and brook trout. Upper Peverly Pond was also stocked with crayfish. Stubbs Pond was stocked with largemouth bass, crayfish, and alewife.

Despite this fishing history, recreational fishing is not currently allowed on the refuge due to concerns with contaminant levels in the sediments and fish and potential risks to human health. Mercury is present in the fish in Upper Peverly Pond. Before any public fishing is allowed, additional fish studies should be done. We will continue to promote other off-refuge fishing opportunities around the Great Bay Estuary.

##### **Strategies**

*Continue to:*

- Keep refuge closed to fishing, but promote fishing opportunities available at established fishing sites around Great Bay.
- Prohibit boats from landing on refuge shoreline.
- Conduct outreach and enforcement to ensure that fishing and boat landings do not occur.

*Within 1 year of CCP approval:*

- Develop a fact sheet on why fishing is not allowed on the refuge and that identifies off-refuge sites where individuals can fish.
- Train volunteers to answer questions about fishing.

*Within 5 years of CCP approval:*

- In conjunction with water quality studies in the Peverly Brook system, establish a schedule to conduct periodic sampling of fish to determine whether they continue to pose a risk to human health if consumed. Establish conditions under which, over time, the refuge might consider opening up to recreational fishing.

#### **GOAL 5.**

**Contribute to the recovery of the federally endangered Karner blue butterfly and other rare Lepidoptera through the conservation, protection, and restoration of the pine barrens habitat.**

#### **Objective 5.1 Habitat Management**

Working with NHFG and other partners, protect, manage, and restore historic pine barren communities in the Concord area, including the refuge’s 29-acre conservation easement, to benefit the federally endangered Karner blue butterfly, other rare Lepidoptera, and shrubland bird species.

##### **Discussion and Rationale**

Great Bay Refuge also includes a 29-acre conservation easement in the pine barrens of Concord, New Hampshire, in Merrimack County (map 4.4). The

property is managed primarily for the federally endangered Karner blue butterfly. The conservation easement is approximately 45 miles west of Great Bay Refuge. The parcel abuts the Concord Airport and is within a fragmented, but important complex of remnant pine barrens habitat that supports rare moths and butterflies. The conservation easement land is a mix of open pitch pine-scrub oak, pine-hardwood, and other scrubland.

Karner blue butterflies inhabit pine barrens, an early successional community composed of 4 distinct vegetative layers: herbaceous, heath, scrub, and canopy. Within the scrub and canopy layer, shade-providing pitch pine and scrub oak dominate. The lower layer includes grasses, vascular plants, and heath. Throughout these layers little bluestem and big bluestem are the principle grass species. New Jersey tea, spreading dogbane, lowbush blueberry, and huckleberry, as well as State threatened wild lupine, blunt-leaved milkweed, and golden heather comprise the majority of the herbaceous and heath layer and provide a critical source of nectar (USFWS 2003).

Currently, Karner blue butterflies are restricted to fragmented pine barren remnants, highway and powerline rights-of-way, airports, military camps, and gaps in forest stands that support their required host plant, wild lupine (USFWS 2003). Karner blue butterflies, as well as other members of the family Lycaenidae, are highly susceptible to environmental changes and population declines. The limiting factors for Karner blue butterflies have been compounded by a severe loss of habitat. Nearly 90 percent of historic pine barren communities along the Merrimack River have been lost (Helmolt and Amaral 1994). This makes the 29-acre Karner blue butterfly conservation easement especially important to the survival of this species in the Concord Pine Barrens. Habitat restoration and management on the Karner blue butterfly conservation easement began in 1996 and has included removal of overstory vegetation using a hydroax, brontosaurus, pruning, and prescribed fire to create openings and grassy patches to allow wild lupine, the host plant of larval Karner blue butterflies, to thrive. The U.S. Department of Agriculture–Wildlife Services assisted with woodchuck removal and fencing to prevent browsing of lupine. Over time, most of the 29 acres has been managed.

In 2004, a spearhead was found on the conservation easement, which changed the pace and process for active management. We have been cooperating with the SHPO to conduct surveys in areas they request. The SHPO has also reviewed the 5-year Lupine Restoration Plan and indicated several areas where they recommend testing occur. An old farm site dating to 1800s is also on the conservation easement. NHFG is developing methods for planting native lupine seed that would avoid conflict with cultural resources.

Concord school kids have helped grow and plant lupine. “Kids for Karners” is a program started by National Wildlife Federation and NHFG around 2000. In the past 9 years, over 1,700 lupine plants have been grown by local school children and planted on the Service’s conservation easement. The project includes a teachers training in the winter, classroom plantings in the spring and a field trip to the conservation easement at the end of the school year to plant lupine and tour the Concord Pine Barrens.

In addition to habitat management on the 29-acre conservation easement, NHFG also currently manages 320 acres within conservation management zone of 450 acres on city of Concord lands. Although, these 320 acres and the Service’s conservation easement provide important habitat for the Karner blue butterfly, additional habitat is needed to help recover the Karner blue butterfly. Historically, natural disturbances and Native American settlement patterns maintained open habitat for Karner blue butterflies in the Northeast. The Karner blue and its required host plant, wild lupine, have persisted in some

developed areas, such as airports, utility rights-of-way, and road edges because moderate human disturbances mimic beneficial natural disturbances. However, urbanization and fragmentation by roads and development in parts of the butterfly's range may have already degraded populations beyond what is needed to maintain viable populations (USFWS 2003, Fuller 2008). The butterfly can disperse across roads but may be hampered by traffic and wind. Also, small, isolated habitat patches do not seem to retain these butterflies (Fuller 2008). Preventing further fragmentation of existing habitats and connecting corridors is an important management priority.

Although intense development and habitat fragmentation continues in the region around the Concord Pine Barrens, the remaining undeveloped lands from the airport south to the Merrimack River are still mostly pine barrens habitat. Historically, the Concord area has always been an important patch of habitat for the Karner blue butterfly population along the Merrimack River corridor. Major development in the corridor has degraded or eliminated habitat; the exclusion of fire has also degraded pine barrens, which is fire-dependent.

NHFG has identified potentially restorable areas between the powerline, which extends through the refuge's conservation easement, and the Merrimack River. This was identified as the best location to focus effort on Karner blue butterfly recovery. Karner blue butterflies have been observed traveling up to 1 mile along the powerline corridor. The Army National Guard is in the process of acquiring the remaining potentially good undeveloped Karner blue habitat south of the current management area. They plan to construct a classroom-training facility in the front section of the property, with a lighter footprint in the back of the property. NHFG intends to work with the Guard on maintaining as much Karner blue butterfly habitat as possible.

### Strategies

#### *Continue to:*

- Compile current cultural resource inventories and, in cooperation with SHPO, identify additional survey work needed to protect cultural resources in conjunction with site plan implementation.
- Support NHFG with habitat management actions, including prescribed burning, when and where resources allow.
- Post and maintain conservation easement boundary and protect habitat from adverse impacts.
- Identify funding sources or mechanisms to maintain sufficient funding for habitat management.

#### *Within 3 years of CCP approval:*

- In partnership with NHFG, the Service's Ecological Services, city of Concord, landowners, and other partners, evaluate role of the refuge in acquiring additional lands—in fee simple or conservation easement—from interested landowners within the focus area, to expand protection and management for the federally endangered Karner blue butterfly (see the discussion on "Land Protection Focus Areas" under "General Refuge Management"). If determined that refuge has a role, then proceed with necessary administrative process. The Service will only acquire lands from willing sellers, either in fee simple or as conservation easements.
- Work with Service's Ecological Services Concord, New Hampshire, office to review the ESA Section 7 consultation for Karner blue butterflies completed for the CCP to ensure that it continues to cover management activities on the conservation easement and adjacent airport, including incidental take.



- Update HMP to include habitat management for the Karner blue butterfly conservation easement. Include information such as which vegetation manipulations should occur, when they should occur, and/or under what conditions. Potential treatment methods including prescribed fire, hydroaxing, brushhogging, herbicides, manual pulling, planting, or seeding of native lupine.
- Facilitate NHFG's efforts to seed native lupines and avoid conflict with cultural resources; schedule archaeological surveys as soon as practicable in high priority lupine seeding sites.
- Support NHFG and the Service's Ecological Services office efforts to protect and manage additional acreages to meet revised population and goals identified in latest population viability model.

#### **Monitoring Components**

- Prioritize monitoring needs in conjunction with site plan implementation.

### **Objective 5.2 Species Management**

In collaboration with New Hampshire Fish and Game and the Karner Blue Butterfly Recovery Team, restore and sustain a viable Karner blue butterfly population for the entire Concord Pine Barrens recovery unit through captive rearing and release. The population goal for the conservation easement is a viable sub-population that produces at least 750 wild-born individuals in any one brood on the Service's conservation easement lands, sustained for at least 4 out of 5 consecutive years.

#### **Discussion and Rationale**

In 1992, the Karner blue butterfly was listed as federally endangered. The population at the Concord Pine Barrens is the only population in New England. The distribution of Karner blue butterflies is largely dependent on the availability of wild lupine, their larval food source, and preferred native nectar sources (Schultz and Dlugosch 1999). These plants occur in pine barrens communities, which occur primarily on glacially deposited sand, shale, and serpentine soil types in parts of eastern North America (NHFG 2006). In New Hampshire, this community type once spanned the Merrimack River valley from Canterbury to Nashua, occupying Windsor sandy loams and Hinckley cobbly sandy loams (VanLoven 1994). Today, only the Concord Pine Barrens supports a population of Karner blue butterflies. The Concord population represents the easternmost extent of this species' distribution and is separated from the nearest population in New York by over 140 miles (225 kilometers) (Helmbolt and Amaral 1994). This butterfly formerly occurred in a band extending across 12 states from Minnesota to Maine and in the province of Ontario, Canada.

Without enough suitable habitats to support a viable population, the Karner blue butterfly was extirpated from New England in 2000 (Amaral 2000), and was subsequently reintroduced. The PSNH lands off Pembroke Road, north of the conservation easement, was the site of the last remaining wild population. In 2000, TNC found only 6 eggs, none of which hatched. NHFG began a captive rearing program in 2000 to restore a viable population. The Karner blue butterfly captive rearing and reintroduction program is funded by the State and paid for with State Moose Plate Grants and Section 6 grants. The first adults from a population in New York were released in 2001. The first eggs and larvae were released in 2003. The program has focused primarily on the rearing and release of adult butterflies. Mark-recapture has been actively implemented since 2004 to track survival and breeding in the wild. The first mark-recapture surveys during the 2004 summer flight resulted in the observation of 22 "wild-born" unmarked Karner blue butterflies on the conservation easement (out of 31 total including surrounding conservation lands on the airport). From 2001 to 2008, butterflies were only released on the conservation easement. The first release of butterflies on non-easement land occurred in 2009 due to a significant increase in

captive reared adult numbers. In 2010, two releases of adult butterflies occurred (over 2,500 individuals in the Concord Pine Barrens).

Karner blue butterflies live only 4 days as adults. Each year, the population can produce two broods, with each brood being a separate generation. The highest population numbers from either brood in a particular year is used for recovery goal population estimates. The Karner Blue Butterfly Recovery Plan has a goal of one viable population in the Concord Pine Barrens recovery unit, consisting of 3,000 wild-born individuals. A viable population is further defined as a minimum 3,000 individuals (in either brood) that is sustained for at least 4 out of 5 consecutive years. Any year that does not meet 3,000 individuals, has to have a minimal population of at least 1,500 individuals, and the final year has to reach at least 3,000 individuals. Recent population viability analyses indicate that 3,000 individuals are not sufficient to sustain a viable population (Fuller 2008), and the recovery goal may be updated in the future.

In 2008, the conservation easement produced 56 wild individuals. In 2010, the entire Concord Pine Barrens produced 313 wild individuals and a total of 3,749 captive-reared individuals were released (1,300 individuals in the first brood; 2,449 individuals in the second brood).

### Strategies

*Continue to:*

- Support the Karner blue butterfly captive rearing and translocation program conducted by NHFG, through the partnership outlined in objective 5.4.
- Implement recovery plan actions when and where possible.

*Within 2 years of CCP approval:*

- Evaluate effectiveness of captive-rearing program and develop milestones for reaching recovery goals.
- Support NHFG and the Service's Ecological Service's efforts to update recovery population goals based on latest population viability model.
- Determine if conservation easement lands are being managed sufficiently and effectively to contribute to Karner blue butterfly management and recovery.

### Monitoring Components

- Support NHFG monitoring program for the Karner blue butterfly on the conservation easement to document recovery as per the Federal Recovery Plan.

## Objective 5.3 Outreach and Education

Within 3 years of CCP approval, install new and expanded interpretive signs and trail on the Karner blue butterfly conservation easement, establish a program of guided walks, create additional Web-based information, and work with partners to improve enforcement on easement lands.

### Discussion and Rationale

The Karner blue butterfly conservation easement is within walking distance of many businesses and residential homes. An unpaved right-of-way runs through the center of the conservation easement, which is gated at each end. A kiosk at the west entrance explains about the ecology of the Karner blue butterfly, but needs updating.

As we described in chapter 3, the conservation easement has a 0.4-mile hiking trail for visitors; however, there is no interpretive signage along the trail to make

the public more aware of the pine barrens ecosystem and associated management issues, and to protect the sensitive areas within the conservation easement. Under this plan, we will develop a 0.1-mile addition to the trail and provide quality self-guided interpretive panels along the entire length.

In addition, more information on the Karner blue, pine barrens, and the conservation easement is needed on the Service's Web site, with links to NHFG and other partners. Law enforcement is a concern given the sensitivity of the resource, proximity to a human population, and lack of any regular onsite staff.

### Strategies

*Continue to:*

- Partner with the “Kids for Karners” program in the Concord schools, coordinated by NHFG and National Wildlife Federation.
- Support existing partnership with the New England Zoo and Aquarium Association to engage volunteers in conservation of local species through activities such as native plant propagation, transplanting, trail construction, and outreach.

*Within 3 years of CCP approval:*

- Add approximately 0.1-mile to the existing 0.4 mile trail and establish self-guided interpretive panels along its length. Panels will explain butterfly ecology and management, to enhance the visitor's understanding and experience. The trail will be clearly designated as the approved footpath to reduce impact on sensitive resources off-trail.
- Upgrade and maintain existing kiosk with interpretive information about butterfly recovery efforts, pine barrens ecology, and warnings about Lyme disease. Construct an additional kiosk on east end of property with similar information.
- Provide volunteer-led group tours and interpretive talks onsite.
- Work with NHFG to develop interpretive materials and information.
- Improve Web site information and link to refuge and NHFG Web sites.
- Develop brochure that describes pine barrens ecology, other dependent species and aspects of biological diversity, in addition to butterfly ecology.
- Have Service law enforcement officers contact NHFG Conservation Officers and Service Special Agents to coordinate on visiting the site and enforcing against unauthorized uses.

### Monitoring Components

- Monitor and evaluate the number of violations and take appropriate action to discourage future infractions.



Matt Poole/USFWS

*Heron nest*

### Objective 5.4 Partnerships

Establish a formal partnership with New Hampshire Fish and Game to continue and enhance the existing collaboration on Karner blue butterfly species and habitat management and develop new partnerships with local businesses, land trusts, and other entities to enhance and expand Karner blue butterfly population and pine barrens habitat restoration.

### Discussion and Rationale

The Karner blue butterfly conservation easement was established in July 1992 through a cooperative agreement between the Service, the city of Concord, the CCDC, the U.S. Postal Service, and TNC. From 1992 to 1999, TNC carried out most of the management on the conservation easement, which included removal of unwanted vegetation by mechanical methods and with prescribed burns and planting of wild lupine. Since 2000, NHFG has conducted the onsite management which has continued with vegetation removal, plantings, moth and butterfly surveys, and a captive rearing program.

The refuge has administrative responsibility for the conservation easement. Given that Great Bay Refuge is unstaffed, these responsibilities lie with the refuge manager at Parker River Refuge. The Service has maintained an informal partnership with NHFG, as they implement onsite management and captive rearing of the Karner blue butterflies. A more formal agreement is needed to ensure that continued funding and support for habitat management, captive rearing, and law enforcement. The Service also seeks to expand other partnerships including with TNC and the New Hampshire Prescribed Fire Council in relation to the use of prescribed fire. Local land trusts and area businesses may be able to help the Service advance its goals of restoring healthy populations of Karner blue butterflies to the Concord Pine Barrens.

### Strategies

*Within 5 years of CCP approval:*

- Participate in New Hampshire Prescribed Fire Council to enhance safety and share resources while implementing prescribed burning on the conservation easement.
- Develop a memorandum of understanding (MOU) with NHFG regarding cooperation and funding for species and habitat management, monitoring, and law enforcement on the conservation easement.
- Develop stronger partnerships with local land conservation groups to assist with recovery of Karner blue butterflies and pine barrens habitat in the area.
- Engage at least 20 percent of the corporate business employees in adjacent industrial park in developing and implementing a volunteer/community service program.

*Refuge shoreline on Great Bay*



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## Chapter 5



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*Public scoping meeting*

# Consultation and Coordination

- Introduction
- Planning Process
- Contact Information
- Planning Team
- Other Service Program Involvement
- Partners Involved in Refuge Planning

## Introduction

This chapter describes how we engaged others in developing this CCP. It details our efforts to encourage the involvement of the public and conservation partners, including other Federal and State agencies, county officials, civic groups, non-government conservation and education organizations, and user groups. It also identifies who contributed significantly to the content or writing of the plan.

According to Service policy, we must review and update our final CCP at least once every 15 years. We may need to revise it sooner, either in response to significant new information that would markedly change management direction, or if the Service Director or our Regional Director deem it necessary. If so, we will once again announce our revised planning and encourage your participation.

## Planning Process

<b>March 12, 2009</b>	Attended a GBRPP meeting in New Hampshire along with representatives from NHFG, TNC, New Hampshire Audubon, SPNHF, and USDA–Natural Resource Conservation Service.
<b>March 25, 2009</b>	Attended a Seabrook, New Hampshire, Estuary Meeting along with Sue Foote of the Seabrook Conservation Commission and Seabrook Selectmen Theresa Walker.
<b>April 15, 2009</b>	Attended a Pease International Airport Wildlife/Bird-Air Strike Hazard Meeting along with representatives of New Hampshire Air National Guard, USDA, New NHFG, and Pease International Tradeport.
<b>April 2009</b>	Conducted a cultural resources site assessment at the Great Bay Refuge in coordination with Regional Service cultural resource staff.
<b>May 20, 2009</b>	Conducted Congressional outreach visits in Washington, D.C., with Senator Jeanne Shaheen, Senator Judd Gregg, and Congresswomen Carol Shea-Porter.
<b>June 2009</b>	Distributed a Great Bay Refuge CCP issues workbook and planning newsletter to approximately 142 individuals. The workbook was also available at refuge headquarters and at outreach events.
<b>June 11, 2009</b>	Attended a GBRPP meeting and distributed copies of the Great Bay CCP issue workbook and planning newsletter to meeting's attendees.
<b>June 17, 2009</b>	Published a Notice of Intent in the <i>Federal Register</i> announcing that we have initiated the planning process for the refuge.
<b>June 18, 2009</b>	Held an Open House and Public Scoping meeting at Town Hall in Newington, New Hampshire; 22 people attended.
<b>June 19, 2009</b>	Attended a Mountain View Hiking Club meeting.
<b>June 25, 2009</b>	Attended a PREP Meeting in New Hampshire along with representatives from the UNH, NHFG, and many other conservation partners.

<b>July 8, 2009</b>	Held a State and Federal agencies partners meeting at Great Bay Discovery Center, in Stratham, New Hampshire.
<b>April 2009 – February 2010</b>	Held six core planning team meetings to discuss goals, objectives, and strategies for each alternative.
<b>March 26, 2010</b>	Held a briefing on the progress of the draft CCP/EA for the Service's Northeast Regional Office Senior Leadership Team.
<b>May 24, 2010</b>	Held a site visit at Great Bay Refuge with State and Federal partners to discuss alternatives for impoundment management on Peverly Brook system.
<b>November 17, 2010</b>	Met with two representatives from the SHPO onsite to look at existing and potentially historic structures.
<b>February 10, 2012</b>	Announced the availability of the draft CCP/EA in the <i>Federal Register</i> for 39 days of public review and comment. We also distributed a newsletter and sent out a press release announcing the public comment period and encouraging people to participate. The <i>Federal Register</i> notice, newsletter, press release, and our planning Web site also announced the two open houses/public meetings we planned for March 8, 2012.
<b>March 8, 2012</b>	Hosted two open houses/public meetings in Newington, New Hampshire. A total of 27 individuals attended the meetings. At each of the meetings, we gave a short overview of the refuge and the CCP planning process. We also recorded all the comments and suggestions provided at the meetings.
<b>March – April 2012</b>	Compiled all of the responses we received during the public comment period. In total, we received 25 written responses representing 23 different signatures and 78 individual comments.
<b>April – May 2012</b>	Considered all the public comments we received and drafted a response to each substantive comment. Based on these substantive comments, we reviewed and revised, where appropriate, the draft CCP/EA. Appendix K summarizes these comments and our responses to them.
<b>June – August 2012</b>	Compiled the final CCP for our Regional Supervisor, Regional Chief, and Regional Solicitor's Office before submitting it to the Regional Director for review and approval. After approval from our Regional Director, we will publish a notice of availability in the <i>Federal Register</i> announcing that the final CCP is complete and explaining how to get a copy of the final plan.

**Contact Information**

**Graham Taylor, Refuge Manager**  
 Parker River National Wildlife Refuge  
 6 Plum Island Turnpike  
 Newburyport, MA 01950  
 Phone: 978-465-5753  
 Email: *Graham\_Taylor@fws.gov*

**Nancy McGarigal**  
 Refuge Planner, U.S. Fish and Wildlife Service, National Wildlife Refuge  
 System, Region 5  
 300 Westgate Center Drive  
 Hadley, MA 01035  
 Phone: 413-253-8562  
 Email: *Nancy\_McGarigal@fws.gov*

**Planning Team**

**Charlie Bridges** *Habitat and Diversity Program Administrator,*  
 New Hampshire Fish and Game Department

**Frank Drauszewski** *Deputy Manager, Parker River National Wildlife Refuge,*  
 U.S. Fish and Wildlife Service

**Sarah Janson** *Biological Technician, Parker River National Wildlife*  
 Refuge, U.S. Fish and Wildlife Service

**Mao Lin** *Former Assistant Planner, U.S. Fish and Wildlife Service,*  
 National Wildlife Refuge System, Region 5 (has transferred  
 to Ecological Services – Gulf of Maine Program)

**Nancy McGarigal** *Refuge Planner, U.S. Fish and Wildlife Service, National*  
 Wildlife Refuge System, Region 5

**Nancy Pau** *Refuge Biologist, Parker River National Wildlife Refuge,*  
 U.S. Fish and Wildlife Service

**Graham Taylor** *Refuge Manager, Parker River National Wildlife Refuge,*  
 U.S. Fish and Wildlife Service

**Peter Wellenberger** *Retired, Manager, Great Bay National Estuarine Research*  
 Reserve, New Hampshire Fish and Game Department

**Other Service Program  
Involvement**

**Meredith Bixby** *Assistant Planner, U.S. Fish and Wildlife Service, National*  
 Wildlife Refuge System, Northeast Regional Office

**Laura Eaton** *Assistant Regional Biologist, U.S. Fish and Wildlife*  
 Service, National Wildlife Refuge System, Northeast  
 Region

**Sarah Morgan** *Former Assistant Planner, U.S. Fish and Wildlife Service,*  
 National Wildlife Refuge System, Northeast Regional  
 Office (has transferred to the private sector)

**Rick Schauffler** *GIS Specialist, U.S. Fish and Wildlife Service, National*  
 Wildlife Refuge System, Northeast Region

**Shelley Small** *Archaeologist, U.S. Fish and Wildlife Service, National*  
 Wildlife Refuge System, Northeast Regional Office

**Doug Smithwood** *Fisheries Biologist, U.S. Fish and Wildlife Service, Central*  
 New England Fisheries Office



<b>Janith Taylor</b>	<i>Former Regional Biologist, U.S. Fish and Wildlife Service, National Wildlife Refuge System, Northeast Region (currently Regional Program Chief, Natural Resources Division, National Wildlife Refuge System, Northeast Regional Office)</i>
<b>John Wilson</b>	<i>Cultural Resources Team Leader, U.S. Fish and Wildlife Service, National Wildlife Refuge System, Northeast Regional Office</i>

## Partners Involved in Refuge Planning

Refuge programs received a great deal of support and input from outside the Service during our planning process. Many of these partners help us with biological surveys, enhancing public use and refuge programs, restoring habitat, law enforcement, and protecting land. Our partnerships will continue to expand under the increasing interest in conserving refuge resources. During the development of the CCP, the following organizations provided input:

- Town of Newington.
- New Hampshire Fish and Game Department: Steve Fuller, Heidi Holman, Glenn Normandeau, Cheri Patterson, Ed Robinson, Lindsay Webb, Steve Weber.
- New Hampshire Coastal Program: Chris Williams.
- Piscataqua Region Estuaries Partnership: Jennifer Hunter, Derek Sowers.
- The Nature Conservancy: Mark Zankel.
- Ibis Wildlife Consulting: Ellen Snyder (Plan Preparer).

## Bibliography

Tom Stehr/USFWS



*White-tailed deer fawn*

## Bibliography

## Bibliography

- Abrams, M.D. 1992. Fire and the development of oak forests. *BioScience* v42(5):346-353.
- Amaral, Michael. 2000. A proposal to translocate Karner blue butterflies (*Lycaeides Melissa samuelis*) from New York to New Hampshire. Prepared for the New York State Department of Environmental Conservation and the U.S. Fish and Wildlife Service Region 5, Endangered Species Office by the Senior Endangered Species Specialist, New England Field Office, Concord, New Hampshire.
- Arbuthnot, M. 2008. A landowner's guide to New England cottontail habitat management. Environmental Defense Fund.
- Askins, R. A. 1997. History of grasslands in the northeastern United States: implications for bird conservation. Pages 119-136 in P. D. Vickery and P. W. Dunwiddie, editors. *Grasslands of northeastern North America: ecology and conservation of native and agricultural landscapes*. Massachusetts Audubon Society, Lincoln, Massachusetts.
- Askins, R. A. 2000. *Restoring North America's birds: lessons from landscape ecology*. Yale University Press, New Haven, Connecticut.
- Atlantic Flyway Council. 2003. Atlantic Flyway mute swan management plan, 2003-2013.
- Bertness, M. D., P. J. Ewanchuk, and B. R. Silliman. 2002. Anthropogenic modification of New England salt marsh landscapes. *Proceedings of the National Academy of Sciences of the United States of America* 99: 1395-1398.
- Bolster, J., editor. 2002. *Cross-grained and wily waters*. Peter E. Randall Publisher, Portsmouth, New Hampshire.
- Bonnichsen, R., G. L. Jacobson, Jr., R. B. Davis, and H. W. Borns, Jr. 1985. The environmental setting for human colonization of northern New England and adjacent Canada in late Pleistocene time. Pages 151-159 in H. W. Borns, Jr., P. LaSalle, and W. B. Thompson, editors. *Late Pleistocene history of northeastern New England and adjacent Quebec*. Geological Society of America Special Paper 197.
- Bowman, P. 2011. Personal communication.
- Bridges, C. 2011. New Hampshire Fish and Game. Personal communication.
- Brown, J. 2008. Great Bay National Wildlife Refuge fish survey report. U.S. Fish and Wildlife Service Central New England Fishery Resources Office, Nashua, New Hampshire.
- Brown, S., C. Hickey, B. Harrington, and R. Gill, editors. 2001. *The U.S. shorebird conservation plan*, 2nd edition. Manomet Center for Conservation Sciences, Manomet, Massachusetts.
- Brownell, K. 2011. U.S. Fish and Wildlife Service. 2011.
- Capel, C. 2006. Maintaining and restoring grasslands. Chapter 3 in J. D. Oehler, D. F. Covell, S. Capel, and B. Long, editors. *Managing grasslands, shrublands, and young forests for wildlife: a guide for the northeast*. The Northeast Upland Habitat Technical Committee, Massachusetts Division of Fisheries and Wildlife.

- Carver, E., and J. Caudill. 2007. Division of Economics US Fish and Wildlife Service "Banking on Nature 2006; The Economic Benefits to Local Communities of National Wildlife Refuge Visitation" Washington, D.C. Accessed at: [http://www.fws.gov/refuges/about/pdfs/BankingOnNature2006\\_1123.pdf](http://www.fws.gov/refuges/about/pdfs/BankingOnNature2006_1123.pdf).
- Chandler, C.C. 2007. Habitat use and survival of Neotropical migrant songbirds during the post-fledging period in the White Mountain National Forest. M.S. Thesis. The University of Massachusetts, Amherst.
- Clark, K. E., and L. J. Niles. 2000. Northern Atlantic regional shorebird plan. New Jersey Division of Fish and Wildlife, Woodbine, New Jersey.
- Clough, J. S., and E. C. Larson. 2009. Application of the sea-level affecting marshes model (SLAMM 5.0) to Great Bay NWR. Warren Pinnacle Consulting, Inc., Warren, Vermont.
- Coup, R.N. and P.J. Pekins. 1999. Field metabolic rate of wild turkeys in winter. *Canadian Journal of Zoology* 77:1075-1082.
- Cronin, W. 1983. Changes in the land: Indians, colonists, and the ecology of New England. Hill and Wang, New York, New York.
- Davis, M. B. 1981. Quaternary history and the stability of forest communities. Pages 133-153 in D.C. West, H.H. Shugart, and D.B. Botkin, editors. Forest succession. Springer-Verlag, New York, New York.
- Davis, M.B. 1983. Holocene vegetational history of the United States. Pages 166-181 in H.E. Wright, Jr, editor. Late-Quaternary environments of the United States, Volume 2: The Holocene. University of Minnesota Press, Minneapolis, Minnesota.
- DeGraaf, R. M., and M. Yamasaki. 2001. New England wildlife: habitat, natural history, and distribution. University Press of New England, Hanover, New Hampshire.
- Department of the Air Force. 2001. Landfill 1—2000 annual report Pease Air Force Base, Portsmouth, New Hampshire. Prepared by Montgomery Watson, Malvern, Pennsylvania.
- Dettmers, R. 2003. Status and conservation of shrubland birds in the northeastern US. *Forest Ecology and Management* 185: 81-93.
- Dettmers, R. 2006. A blueprint for the design and delivery of bird conservation in the Atlantic northern forest. U.S. Fish and Wildlife Service, Hadley, Massachusetts.
- Dettmers, R., and K. V. Rosenberg. 2000. Partners in Flight landbird conservation plan, physiographic area 9: Southern New England. American Bird Conservancy, Arlington, Virginia.
- Dodds, K. J., and R. Cooke. 2006. Forest health assessment Great Bay National Wildlife Refuge. U.S. Forest Service, Forest Health Protection, Durham Field Office, Durham, New Hampshire.
- Drury, W. H. 1973. Population changes in New England seabirds. *Bird-banding*, 44:267-313.

- Foley, N.K., R.A. Ayuso, J.D. Ayotte, D.L. Montgomery, and G.R. Robinson, Jr. 2006. Geological assessment of cores from Great Bay National Wildlife Refuge, New Hampshire. U.S. Geological Survey, U.S. Department of the Interior. Scientific Investigations Report 2006-5203.
- Foss, C. R. 1992. Wildlife in a changing landscape. Pages 14-22 in R. Ober, editor. At what cost? Shaping the land we call New Hampshire. New Hampshire Historical Society and the Society for the Protection of NH Forests, Concord, New Hampshire.
- Foster, D. R., and G. Motzkin 2003. Interpreting and conserving the openland habitats of coastal New England: insights from landscape history. *Forest Ecology and Management*, 185:127-150.
- Foster, D.R., G. Motzki, D. Bernardos, and J. Cardoza. 2002. Wildlife dynamics in the changing New England landscape. *Journal of Biogeography*, 29:1337-1357.
- Frederickson, L. 1999. University of Missouri. Personal communication.
- Frumhoff, P.C., J.J. McCarthy, J.M. Melillo, S.C. Moser, and D.J. Wuebbles. 2007. Confronting climate change in the U.S. Northeast: Science, impacts, and solutions. Synthesis report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA: Union of Concerned Scientists (UCS). July 2007. 160 pp.
- Fuller, S. G. 2008. Population dynamics of the endangered Karner blue butterfly (*Lycaeides melissa samuelis*) Dissertation, SUNY. Syracuse, New York.
- Graham, R. W. 1992. Late Pleistocene faunal changes as a guide to understanding the effects of greenhouse warming on the mammalian fauna of North America. Pages 76-87 in R.L. Peters and T.E. Lovejoy, editors. *Global Warming and Biological Diversity*. Yale University Press, New Haven, Connecticut.
- Grant, E.H.C, R. E. Jung, J.D. Nichols, and J.E. Hines. 2005. Double-observer approach to estimating egg mass abundance of pool-breeding amphibians. *Wetlands Ecology and Management* 13:305-320.
- Greater Portsmouth Chamber of Commerce (GPCC). 2006. Portsmouth is an Established Hub of Global Trade. Portsmouth, New Hampshire. Accessed at: [www.portsmouthchamber.org/globaltrade2006.cfm](http://www.portsmouthchamber.org/globaltrade2006.cfm).
- Greenlaw, J. S., and J. D. Rising. 1994. Sharp-tailed sparrow (*Ammodramus caudacutus*). In *The Birds of North America*, No. 112 (A. Poole and F. Gill, Eds). Philadelphia: The Academy of Natural Sciences, Washington, D.C.
- Helmbolt, K., and M. Amaral. 1994. Status of the Karner blue butterfly in New Hampshire. Pages 123-128 in D.A. Andow, R.J. Baker, and C.P. Lane, eds. *Karner blue butterfly: a symbol of a vanishing landscape*. Minnesota Agricultural Experiment Station. St. Paul, Minnesota.
- Hodgman, T. P., and K. V. Rosenberg. 2000. Partners in flight bird conservation plan for the Northern New England physiographic area 27.
- Hunt, P. 2009. The State of New Hampshire's Birds *prepared by* the Conservation Division, New Hampshire Audubon *for* the Nongame and Endangered Wildlife Program, New Hampshire Fish and Game Department. December 2009. 51 pg.



- Hunt, P. and D. De Luca. 2011. New Hampshire Audubon. Personal communication.
- Inkley, D. B., M. G. Anderson, A. R. Blaustein, V. R. Burkett, B. Felzer, B. Griffith, J. Price, and T. L. Root. 2004. Global climate change and wildlife in North America. Technical Review 04-2. The Wildlife Society, Bethesda, Maryland.
- Joint Sciences Academies' Statement. 2005. Accessed June 2012 at: <http://www.nationalacademies.org/onpi/06072005.pdf>
- Jones, S. H., editor. 2000. A Technical Characterization of Estuarine and Coastal New Hampshire. Jackson Estuarine Laboratory, University of New Hampshire, Durham, USA.
- Kovach, A. and L. Fenderson. 2000. Conservation genetics of New England Cottontail: insight from broad-scale (range-wide) and fine-scale (Maine & New Hampshire) Investigations, A report for managers. University of New Hampshire, Durham, NH.
- Kushlan, J. A., M. J. Steinkamp, K. C. Parsons, J. Capp, M. A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R. M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J. E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird conservation for the Americas: the North American waterbird conservation plan, version 1. Waterbird Conservation for the Americas. Washington, DC, U.S.A.
- Lane, O.P., A. Major, K. O'Brien, N. Pau and D.C. Evers. 2008. Methylmercury availability in New England estuaries as indicated by salt marsh sharp-tailed sparrows, 2004-2007. Report BRI 2008-11. Biodiversity Research Institute, Gorham, Maine.
- Lenhart, C.F. 2000. The vegetation and hydrology of impoundments after dam removal in southern Wisconsin. Master's Thesis. University of Wisconsin, Madison, WI.
- Litvaitis, J. A. 2003. Are pre-Columbian conditions relevant baselines for managed forests in the northeastern United States? *Forest Ecology and Management*, 185:113-126.
- Lorimer, C. G. 1977. The presettlement forest and natural disturbance cycle of northeastern Maine. *Ecology*, 58:139-148.
- Lorimer, C. G. 2001. Historical and ecological roles of disturbance in eastern North American forests: 9,000 years of change. *Wildlife Society Bulletin* 29: 425-439.
- Lorimer, C.G., and A.S. White. 2003. Scale and frequency of natural disturbances in the northeastern US: implications for early successional forest habitats and regional age distributions. *Forest Ecology and Management*, 185:41-64.
- Major, D. 2009. U.S. Fish and Wildlife Service. Personal communication.
- Manomet Center. 2010. Climate change and biodiversity in Maine: A climate change exposure summary for participants of the Maine Climate Change Species Vulnerability Assessment. Natural Capital Initiative at Manomet. NCI-2010-02.

- Martin, C. 2011. New Hampshire Audubon. Personal communication.
- Marchand, P. J. 1987. North woods: an inside look at the nature of forests in the Northeast. Appalachian Mountain Club, Boston, Massachusetts.
- McKinley, P. and P. Hunt. 2008. Avian use of the Hampton-Seabrook Estuary: 2006-2007. New Hampshire Audubon, Concord, New Hampshire.
- Memorandum of Agreement. 1992. Memorandum of Agreement, U.S. Fish and Wildlife Service, Federal Aviation Administration, U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control, and Pease Development Authority.
- Mills, K. 2009. Ecological trends in the Great Bay Estuary. 20 year anniversary report. Great Bay National Estuarine Research Reserve, Durham, New Hampshire.
- National Invasive Species Council. 2001. Meeting the invasive species challenge: national invasive species management plan. Washington, D.C.
- New Hampshire Department of Environmental Services–Coastal Program (NHDES). 2005a. A Volunteer's Handbook for Monitoring New Hampshire Salt Marshes. September 2005. Accessed online December 2011 at: <http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-04-21.pdf>.
- New Hampshire Department of Environmental Services–Coastal Program (NHDES). 2005b. Life in New Hampshire Salt Marshes: Quick Reference Field Guide. June 2005. Accessed online December 2011 at: <http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-04-19.pdf>.
- New Hampshire Estuaries Project. 2006. State of the estuaries 2006. New Hampshire Estuaries Project, Durham, New Hampshire.
- New Hampshire Fish and Game. 2005. New Hampshire Wildlife Action Plan. New Hampshire Fish and Game Department, Concord, New Hampshire.
- New Hampshire Fish and Game. 2006. Species Profile: Karner blue butterfly (*Lycaeides melissa samuelis*). New Hampshire Fish and Game Department, Concord, New Hampshire.
- New Hampshire Natural Heritage Bureau (NHB). 2010. Rare Plants, Rare Animals, and Exemplary Natural Communities in New Hampshire Towns. July 2010. Accessed at: <http://www.nhdf.org/library/pdf/Natural%20Heritage/Townlist.pdf>.
- Norment, C. 2002. On grassland bird conservation in the northeast. *The Auk*, 119:271-279.
- Odell, J., A. Eberhardt, D. Burdick, and P. Ingraham. 2006. Great Bay estuary compendium. The Nature Conservancy, Concord, New Hampshire.
- Patterson, W. A., III, and K. E. Sassaman. 1988. Indian fires in the prehistory of New England. Pages 107-135 in G.P. Nicholas, editor. *Holocene human ecology in northeastern North America*. Plenum Press, New York, New York.

- Peteroy, A.V. 1998. 1998 Karner blue butterfly (*Lycaeides melissa samuelis*) captive rearing results: Concord Pine Barrens, Concord New Hampshire. The Nature Conservancy, Concord, New Hampshire.
- Pimentel, D., L. Lach, R. Zuniga, and D. Morrison. 2000. Environmental and economic costs of nonindigenous species in the United States. *BioScience* 50:53-65.
- Pinkney, A. E., S. K. Krest, L. Eaton-Poole, and D. R. Sutherland. 2006. Investigation of Contaminant Effects on Frog Development at Great Bay National Wildlife Refuge, Newington, NH. U. S. Fish and Wildlife Service, Annapolis, Maryland. May 2006. 288pp.
- Piscataqua Region Estuaries Partnership. 2009. State of the estuaries 2009. Piscataqua Region Estuaries Partnership, University of New Hampshire, Durham, New Hampshire.
- Piscataqua Region Estuaries Partnership. 2010. Piscataqua region comprehensive conservation and management plan. Piscataqua Region Estuaries Partnership, University of New Hampshire, Durham, New Hampshire.
- Robinson, E. 2011. New Hampshire Fish and Game. Personal communication.
- Rodenhouse, N.L., S.N. Matthews, K.P. McFarland, J.D. Lambert, L.R. Iverson, A. Prasad, T.S. Sillett, and R.T. Holmes. 2008. Potential effects of climate change on birds of the Northeast. *Mitigation and Adaptation Strategies for Global Change*. In press.
- Rowe, J. F. 1987. Newington New Hampshire, a heritage of independence since 1630. Phoenix Publishing, Canaan, New Hampshire.
- Schmidt, K. A. and Whelan, C. J. (1999), Effects of Exotic *Lonicera* and *Rhamnus* on Songbird Nest Predation. *Conservation Biology*, 13: 1502–1506.
- Schroeder, M. J. 1970. Fire weather: a guide for application of meteorological information to forest fire control Operations. U.S. Department of Agriculture, Publication # 360, 229pp.
- Schultz, C. B., and K. M. Dlugosch. 1999. Nectar and host plant scarcity limit populations of an endangered Oregon butterfly. *Oecologia* 119: 231-38.
- Short, F. T., P. F. Sale, and J. A. Guy. 1992a. Characterization of estuarine habitats. Pp 25-30 *In*. F. T. Short edited The Ecology of the Great Bay Estuary, New Hampshire and Maine: an estuarine profile and biography. University of New Hampshire, Durham, New Hampshire.
- Short, F. T., S. H. Jones, P. F. Sale, and P. Wellenberger. 1992b. Great Bay estuary management issues. Pp 145-164 *In*. F. T. Short edited The Ecology of the Great Bay Estuary, New Hampshire and Maine: an estuarine profile and biography. University of New Hampshire, Durham, New Hampshire.
- Smith, B. 2004. What's good for the goose. *Wildlife Journal*. New Hampshire Fish and Game Department, Concord, New Hampshire.
- Smithwood, D. 2009. U.S. Fish and Wildlife Service. Personal communication.

- Sperduto, D. 2000. Vegetation mapping summary for the Great Bay National Wildlife Refuge. New Hampshire Natural Heritage Program, Concord, New Hampshire.
- Sperduto, D. 2010. Vegetation mapping summary for the Great Bay National Wildlife Refuge. New Hampshire Natural Heritage Program, Concord, New Hampshire.
- Sperduto, D., and William F. Nichols. 2004. Natural Communities of New Hampshire. NH Natural Heritage Bureau, Concord, NH. Pub. UNH Cooperative Extension, Durham, New Hampshire.
- Steincamp, M. 2006 (draft). Mid Atlantic/southern New England bird conservation region 30 implementation plan. Atlantic Coast Joint Venture, Laurel, Maryland.
- Taylor, J., T. D. Thomas, and L. F. McCarthy. 1996. New Hampshire's living legacy: the biodiversity of the granite state. New Hampshire Fish and Game Department, Concord, New Hampshire.
- Tefft, B. C. 2006. Managing shrublands and old fields. Chapter 4 in J. D. Oehler, D. F. Covell, S. Capel, and B. Long, editors. Managing grasslands, shrublands, and young forests for wildlife: a guide for the northeast. The Northeast Upland Habitat Technical Committee, Massachusetts Division of Fisheries and Wildlife.
- U.S. Department of Agriculture. 1994. Soil survey of Rockingham County, New Hampshire, Parts 1 and 2. USDA Soil Conservation Service in cooperation with the New Hampshire Experiment Station.
- U.S. Department of Commerce (USDOC), Census Bureau. 2007. 2005-2007 American Community Survey. Accessed at: <http://factfinder.census.gov>.
- U.S. Environmental Protection Agency. 2011. Air Quality Index Report: Rockingham County, New Hampshire. [http://www.epa.gov/airdata/ad\\_rep\\_aqi.html](http://www.epa.gov/airdata/ad_rep_aqi.html).
- U.S. Fish and Wildlife Service. 1993. Hunt Plan, Great Bay National Wildlife Refuge, Newington, New Hampshire. U.S. Fish and Wildlife Service.
- U.S. Fish and Wildlife Service. 1994. Great Bay National Wildlife Refuge fisheries management plan. U.S. Fish and Wildlife Service, Newington, New Hampshire.
- US Fish and Wildlife Service. 1995. Environmental assessment of public hunting of white-tailed deer and waterfowl on Great Bay National Wildlife Refuge. U.S. Fish and Wildlife Service, Newington, New Hampshire.
- U.S. Fish and Wildlife Service. 1999. Fulfilling the promise: the national wildlife refuge system. U.S. Fish and Wildlife, Washington, D.C.
- U.S. Fish and Wildlife Service. 2003. Final recovery plan for the Karner blue butterfly (*Lycaeides melissa samuelis*). U.S. Fish and Wildlife Service, Fort Snelling, Minnesota.
- U.S. Fish and Wildlife Service. 2004. Writing refuge management goals and objectives: A handbook. 34pp.

- U.S. Fish and Wildlife Service. 2007. National bald eagle management guidelines. U.S. Fish and Wildlife Service, Arlington, Virginia.
- U.S. Fish and Wildlife Service. 2008. Birds of conservation concern 2008. United States Department of the Interior, Division of Migratory Bird Management, Arlington, Virginia.
- U.S. Fish and Wildlife Service. 2009. U.S. Fish and Wildlife Service Refuge contaminant assessments website <http://ecos.fws.gov/cap/viewPublicSummaries.do>.
- U.S. Fish and Wildlife Service. 2009a. Northeast region fisheries program strategic plan: fiscal years 2009-2013.
- U.S. Fish and Wildlife Service. 2009b. Rising to the urgent challenge: strategic plan for responding to accelerating climate change.
- U.S. Fish and Wildlife Service. 2009c. Great Bay National Wildlife Refuge visitor service's review. U.S. Fish and Wildlife Service, Region 5.
- U.S. Fish and Wildlife Service. 2010. *Strategic Plan for Inventories and Monitoring on National Wildlife Refuges: Adapting to Environmental Change*.
- U.S. Fish and Wildlife Service and Canadian Wildlife Service. 2004. North American waterfowl management plan.
- U.S. Fish and Wildlife Service (USFWS) and U.S. Department of Commerce (USDOC), U.S. Census Bureau. 2002. 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Accessed at: <http://www.census.gov/prod/2003pubs/01fhw/fhw01-nh.pdf>.
- U.S. Fish and Wildlife Service (USFWS) and U.S. Department of Commerce (USDOC), U.S. Census Bureau. 2007. 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Accessed at: <http://www.census.gov/prod/2008pubs/fhw06-nh.pdf>.
- U.S. Geological Survey (USGS). 2006. Nesting Ecology and Nesting Habitat Requirements of Ohio's Grassland-nesting Birds: A Literature Review. North Prairie Wildlife Research Center. <http://www.npwrc.usgs.gov/resource/birds/ohionest/sandpipe.htm>
- University of Delaware. 2008. The Mummichog (*Fundulus heteroclitus*). Accessed at: <http://www.ceoe.udel.edu/kiosk/mummichog.html>.
- VanLuven, D. E. 1994. Site conservation plan for the Concord Pine Barrens, Concord New Hampshire. The Nature Conservancy, Concord, New Hampshire.
- Vitz, A.C. and A.D. Rodewald. 2006. Can regenerating clearcuts benefit mature-forest songbirds? An examination of post-breeding ecology. *Biological Conservation*. v127:477-486.
- Vitz, A. C. and A.D. Rodewald. 2007. Vegetative and fruit resources as determinants of habitat use by mature-forest birds during the postbreeding period. *The Auk*. v124(2):494-507.
- Vogel, L. 1995. Wintering waterfowl on Great Bay. Technical Report No. 2. Great Bay National Estuarine Research Reserve, Stratham, New Hampshire.



- Wake, C, K. Carpenter, J. Cox, J. Souney, P. Sanborn, and M. Rodgers. 2004. Air quality in New England. University of New Hampshire, Durham. Published at: <http://www.airmap.sr.unh.edu/background/airQuality.html>.
- Walsh, J. 2009. Patterns of population structure and productivity in salt marsh sparrows. Masters of Science Thesis. University of New Hampshire, Durham, New Hampshire.
- Wigley, T.W. 2004. The science of climate change: global and U.S. perspectives. National Center for Atmospheric Research, Washington, D.C.
- Wilcove, D.S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. *BioScience* 48:607-615.
- Williams, C. 2007. New Hampshire Coastal Program. Personal communication.
- Williams, B.K., R.C. Szaro, C.D. Shapiro. 2007 Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group. U.S. Department of the Interior. Washington D.C.
- Winne, J. C. 1997. History of vegetation and fire on the Pineo Ridge pine grassland barrens of Washington County, Maine. Pages 25-52 in P. D. Vickery and P. W. Dunwiddie, editors. Grasslands of northeastern North America: ecology and conservation of native and agricultural landscapes. Massachusetts Audubon Society, Lincoln, Massachusetts.
- Yates, D. and D. Meattey. 2010. Bat survey on Parker River and Great Bay NWR 2008-09. Biodiversity Research Institute Report, Gorham, Maine.
- Zankel, M., C. Copeland, P. Ingraham, J. Robinson, C. Sinnott, D. Sundquist, T. Walker, and J. Alford. 2006. The Land Conservation Plan for New Hampshire's Coastal Watersheds. The Nature Conservancy, Society for the Protection of New Hampshire Forests, Rockingham Planning Commission, and Strafford Region Planning Commission. Prepared for the New Hampshire Coastal Program and the New Hampshire Estuaries Project, Concord, New Hampshire.

## Glossary



*New England cottontail*

## Glossary, Acronyms, and Species Scientific Names

- Glossary
- Acronyms
- List of Species and Their Scientific Names

## Glossary

<b>adaptive management</b>	a process in which projects are implemented within a framework of scientifically driven experiments to test predictions and assumptions outlined within the comprehensive conservation plan. The analysis of the outcome of project implementation helps managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.
<b>abiotic</b>	nonliving; a physical feature of the environment such as climate, temperature, geology, soils
<b>alternative</b>	a set of objectives and strategies needed to achieve refuge goals and the desired future condition.
<b>ambient</b>	of the surrounding area or outside environment
<b>anadromous fish</b>	fish that spend a large portion of their life cycle in the ocean and return to freshwater to breed.
<b>appropriate use</b>	<p>a proposed or existing use on a refuge that meets at least one of the following three conditions:</p> <ol style="list-style-type: none"> <li>1. The use is a wildlife-dependent one.</li> <li>2. The use contributes to fulfilling the refuge purpose(s), the System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the National Wildlife Refuge System Improvement Act was signed into law.</li> <li>3. The use has been determined appropriate as specified in section 1.11 of that act.</li> </ol>
<b>approved acquisition boundary</b>	a project boundary that the Director of the U.S. Fish and Wildlife Service approves upon completion of the planning and environmental compliance process. An approved acquisition boundary only designates those lands that the Service has authority to acquire or manage through various agreements. The approval of an acquisition boundary does not grant the Service jurisdiction or control over lands within the boundary, and it does not make lands within the refuge boundary part of the National Wildlife Refuge System. Lands do not become part of the System until the Service buys them or they are placed under an agreement that provides for their management as part of the System
<b>avian</b>	of or having to do with birds
<b>basin</b>	the surrounding land that drains into a water body.
<b>bathymetry</b>	the measurement of the depth of bodies of water
<b>best management practice</b>	land management practices that produce desired results (usually describing forestry or agricultural practices effective in reducing non-point source pollution.
<b>bioaccumulation</b>	an increase in concentration of a chemical in an organism at a higher level than expected.
<b>biological diversity</b>	the variety of life forms and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.
<b>biological integrity</b>	biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including natural biological processes that shape genomes, organisms, and communities.

<b>bird conservation region</b>	ecologically distinct regions in North America with similar bird communities, habitats, and resource management issues.
<b>buffer</b>	lands bordering water bodies that reduce runoff and nonpoint source pollution
<b>canopy</b>	the layer of foliage formed by the crowns of trees in a stand. For stands with trees of different heights, foresters often distinguish among the upper, middle, and lower canopy layers. These represent foliage on tall, medium, and short trees. The uppermost layers are called the overstory.
<b>catadromous</b>	refers to fish that migrate from freshwater to saltwater to spawn and reproduce.
<b>categorical exclusion</b>	a category of Federal agency actions that do not individually or cumulatively have a significant effect on the human environment.
<b>compatible use</b>	a wildlife-dependent recreational use, or any other use on a refuge that will not materially interfere with or detract from the fulfillment of the mission of the Service or the purposes of the refuge.
<b>compatibility determinations</b>	a required determination for wildlife-dependent recreational uses or any public uses of a refuge.
<b>Comprehensive Conservation Plan</b>	a document that describes the desired future conditions of the refuge, and specifies management direction to achieve refuge goals and the mission of the National Wildlife Refuge System.
<b>community</b>	a distinct assemblage of plants that develops on sites characterized by particular climates and soils, and the species and populations of wild animals that depend on the plants for food, cover and/or nesting.
<b>conservation easement</b>	a legal agreement between a landowner and a land trust or governmental agency that permanently limits some uses of a property to protect its conservation values.
<b>cover type</b>	the current vegetation of an area.
<b>cultural resource</b>	those parts of the physical environment—natural and built—that have cultural values to some sociocultural group or institution. Cultural resources include historic sites, archaeological sites and associated artifacts, sacred sites, buildings, and structures.
<b>diameter at breast height</b>	(dbh)—the diameter of the stem of tree measure at breast height (usually 4.5 feet above the ground). The term is commonly used by foresters to describe tree size.
<b>disturbance</b>	a disruption in the natural plant succession of a community or ecosystem resulting in a new community.
<b>early successional habitat</b>	Succession is the gradual replacement of one plant community by another. In a forested ecosystem, tree cover can be temporarily displaced by natural or human disturbance (e.g., flooding by beaver, or logging). The open environments created by removal of tree cover are referred to as ‘early-successional’ habitats because as time passes, trees will return. The open conditions occur ‘early’ in the sequence of plant communities that follow disturbance. Early successional habitats include grassland and shrubland, and can also include young forests in the shrub-sapling stage (approximately 0 to 15 years old).

<b>ecological integrity</b>	native species populations in their historic variety and numbers naturally interacting in naturally structured biotic communities. For communities, integrity is governed by demographics of component species, intactness of landscape-level ecological processes (e.g., natural fire regime), and intactness of internal community processes (e.g., pollination).
<b>ecological succession</b>	the orderly progression of an area through time in the absence of disturbance from one vegetative community to another.
<b>ecoregion</b>	a territory defined by a combination of biological, social, and geographic criteria, rather than geopolitical considerations; generally, a system of related, interconnected ecosystems.
<b>ecosystem</b>	a dynamic and interrelated complex of plant and animal communities and their associated non-living environment.
<b>elver</b>	life stage of an eel; young eels
<b>emergent marsh</b>	wetlands dominated by erect, rooted, herbaceous plants.
<b>endangered species</b>	any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the <i>Federal Register</i> .
<b>Environmental Assessment</b>	a systematic analysis to determine if proposed actions would result in a significant effect on the quality of the environment.
<b>environmental health</b>	the composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment.
<b>exotic species</b>	a species that is not native to an area and has been introduced intentionally or unintentionally by humans.
<b>extinction</b>	the termination of existence of a lineage of organisms (e.g., a subspecies or species).
<b>extirpation</b>	the localized extinction of a species that is no longer found in a locality or country, but still exists elsewhere in the world.
<b>federally listed species</b>	a species listed either as endangered, threatened, or species at risk (formerly a “candidate” species) under the Endangered Species Act of 1973, as amended.
<b>fee-simple acquisition</b>	absolute title to the land, free of any other claims against the title.
<b>fee-title acquisition</b>	the acquisition of most or all of the rights to a tract of land; a total transfer of property rights with the formal conveyance of a title.
<b>fragmentation</b>	the process of reducing the size and connectivity of habitat patches. The disruption of extensive habitats into isolated and small patches.
<b>geographic information system</b>	a computer system capable of storing and manipulating spatial mapping data; more commonly referred to by the acronym GIS
<b>glacial outwash</b>	glacial drift deposited by water flowing from a melting glacier.



<b>glacial till</b>	a mixture of sand, silt, clay, and rock ground up by a glacier and dropped as it retreats.
<b>goals</b>	descriptive statements of desired future conditions.
<b>habitat</b>	the sum of environmental factors—food, water, cover, and space—that each species needs to survive and reproduce in an area.
<b>hectare</b>	equal to 2.47 acres
<b>hibernaculum, -a</b>	shelter for a hibernating species
<b>historic conditions</b>	the composition, structure, and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, were present prior to substantial human-related changes to the landscape.
<b>impoundment</b>	a body of water, such as a pond, confined by a dam, dike, floodgate, or other barrier, that is used to collect and hold water.
<b>interjurisdictional fish</b>	populations of fish that are managed by two or more State or national or tribal governments because of the scope of their geographic distributions or migrations.
<b>invasive species</b>	a non-native species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
<b>issue</b>	any unsettled matter that requires a management decision. For example, a resource management problem, concern, a threat to natural resources, a conflict in uses, or in the presence of an undesirable resource condition.
<b>limiting factor</b>	an environmental limitation that prevents further population growth
<b>microhabitats</b>	a small, specific habitat such as under a log or a hole in a tree.
<b>migratory bird</b>	a bird species that migrates between wintering and breeding grounds.
<b>millinery trade</b>	the use of bird feathers in women's hats and other clothing.
<b>National Wildlife Refuge System</b>	all lands, waters, and interests therein administered by the U.S. Fish and Wildlife Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish, wildlife, and plant resources
<b>nonpoint source pollution</b>	a diffuse form of water quality degradation in which wastes are not released at one specific, identifiable point but from a number of points that are spread out and difficult to identify and control.
<b>objectives</b>	actions to be accomplished to achieve a desired outcome or goal. Objectives are more specific, and generally more measurable, than goals.
<b>physiographic area</b>	a bird conservation planning unit with relatively uniform vegetative communities, bird populations, and species assemblages, as well as land use and conservation issues, developed by Partners in Flight.
<b>point source pollution</b>	a source of pollution that involves discharge of waste from an identifiable point, such as a smokestack or sewage-treatment plant.

<b>preferred alternative</b>	the Service's selected alternative identified in the Draft Comprehensive Conservation Plan.
<b>prescribed burning/fire</b>	the application of fire to wildland fuels, either by natural or intentional ignition, to achieve identified land use objectives.
<b>priority public use</b>	a compatible wildlife-dependent recreational use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation.
<b>range</b>	the geographic area within which a particular species is found.
<b>relative abundance</b>	an estimate of actual or absolute abundance, usually stated as an index.
<b>restoration</b>	management of a disturbed or degraded habitat that results in the recovery of its original state (e.g., restoration may involve planting native species, removing invasive shrubs, prescribed burning).
<b>riparian</b>	relating the floodplains, banks, and terraces that line rivers.
<b>riparian area</b>	habitat along the banks of a stream, river, or wetland.
<b>scoping</b>	a process for determining the scope of issues to be addressed by a comprehensive conservation plan and for identifying the significant issues. Involved in the scoping process are Federal, State, and local agencies; private organizations; and individuals.
<b>shifting mosaic</b>	an interconnected patchwork of distinct vegetation types that may shift across the land surface as a result of dynamic ecosystem processes, such as periodic wildfire or flooding.
<b>spawning</b>	the act of reproduction of fishes—the mixing of the sperm from the male fish and the eggs of a female fish.
<b>special use permit</b>	a permit authorized by the refuge manager for an activity that is not usually available to the general public.
<b>species</b>	a distinctive kind of plant or animal having distinguishable characteristics, and that can interbreed and produce young. In taxonomy, a category of biological classification that refers to one or more populations of similar organisms that can reproduce with each other but is reproductively isolated from—that is, incapable of interbreeding with—all other kinds of organisms.
<b>species richness</b>	a simple measure of species diversity calculated as the total number of species in a habitat or community.
<b>stand</b>	an easily defined area of the forest that is relatively uniform in species composition or age and can be managed as a single unit.
<b>stopover habitat</b>	habitat where birds rest and feed during migration. Also called staging area.
<b>strategies</b>	a general approach or specific actions to achieve objectives.
<b>structure</b>	the horizontal and vertical arrangement of trees and other vegetation having different sizes, resulting in different degrees of canopy layering, tree heights, and diameters within a stand.

<b>succession</b>	the natural, sequential change of species composition of a community in a given area
<b>terrestrial</b>	living on land.
<b>threatened species</b>	those plant or animal species likely to become endangered species throughout all of or a significant portion of their range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the <i>Federal Register</i> .
<b>torpor</b>	a state of decreased activity in an animal, usually short-term, often characterized by a reduced body temperature and rate of metabolism
<b>trust resources</b>	national resources entrusted by Congress to the U.S. Fish and Wildlife Service for conservation and protection. These “trust resources” include migratory birds, federally listed endangered and threatened species, inter-jurisdictional fishes, wetlands, and certain marine mammals.
<b>understory</b>	the lower layer of vegetation in a stand, which may include short trees, shrubs, and herbaceous plants
<b>vernal pool</b>	depressions holding water for a temporary period in spring and other high water periods, and in which several species of amphibians lay eggs.
<b>water rights</b>	the right of a user to use water from a source such as a river, stream, pond, or groundwater source.
<b>watershed</b>	the geographic area within which water drains into a particular river, stream, or body of water. A watershed includes both the land and the body of water into which the land drains.
<b>Wilderness Area</b>	An area designated by Congress as part of the National Wilderness Preservation System
<b>wilderness study area</b>	Lands and waters identified by inventory as meeting the definition of wilderness and being evaluated for a recommendation that they be included in the Wilderness System.
<b>wildfire</b>	an unplanned, unwanted wildland fires including unauthorized human-caused fires, escaped wildland fires, escaped prescribed fires, and all other wildland fires where the objective is to put the fire out.
<b>wildland fire</b>	any non-structure fire that occurs in the wildland. Three distinct types of wildlife fire have been defined and include wildfire, wildland fire use, and prescribed fire.
<b>wildlife-dependent recreation</b>	A use of a Refuge involving hunting, fishing, wildlife observation, wildlife photography, environmental education, or interpretation. The National Wildlife Refuge System Improvement Act of 1997 specifies that these are the six priority general public uses of the National Wildlife Refuge System.

## Acronyms

<b>ACJV</b>	Atlantic Coast Joint Venture
<b>AFWA</b>	Association of Fish and Wildlife Agencies
<b>AHPA</b>	Archaeological and Historic Preservation Act
<b>AHWP</b>	Annual Habitat Work Plan
<b>ARPA</b>	Archaeological Resources Protection Act
<b>BCC</b>	Birds of Conservation Concern
<b>BCR</b>	Bird Conservation Region
<b>BIDEH</b>	Biological integrity, diversity, environmental health
<b>BRI</b>	Biodiversity Research Institute
<b>BTI</b>	<i>Bacillus thuringiensis</i> , an insecticide to control mosquitoes
<b>CCDC</b>	Concord Community Development Corporation
<b>CCP</b>	Comprehensive Conservation Plan
<b>CEQ</b>	Council on Environmental Quality
<b>CFR</b>	Code of Federal Regulations
<b>CWIPP</b>	Coastal Watershed Invasive Plant Partnership
<b>CWS</b>	Canadian Wildlife Service
<b>dbh</b>	diameter at breast height
<b>DDT</b>	a synthetic pesticide, dichlorodiphenyltrichloroethane
<b>DOD</b>	U.S. Department of Defense
<b>EA</b>	Environmental Assessment
<b>EIS</b>	Environmental Impact Statement
<b>EPA</b>	Environmental Protection Agency
<b>ESA</b>	Endangered Species Act of 1973
<b>FAA</b>	Federal Aviation Administration
<b>FONSI</b>	Finding of No Significant Impact
<b>GBNERR</b>	Great Bay National Estuarine Research Reserve
<b>GBRPP</b>	Great Bay Resource Protection Partnership
<b>GIS</b>	Geographic Information System
<b>GOMI</b>	Gulf of Maine Institute
<b>HMP</b>	Habitat Management Plan

<b>IBA</b>	Important Bird Area
<b>IMP</b>	Inventory and Monitoring Plan
<b>IPCC</b>	International Panel on Climate Change
<b>IPM</b>	Integrated pest management
<b>LCC</b>	Landscape Conservation Collaborative
<b>LEED</b>	Leadership in Energy and Environmental Design
<b>LMRD</b>	Land Management Research and Demonstration program
<b>LPP</b>	Lower Peverly Pond
<b>LWCF</b>	Land and Water Conservation Fund
<b>MANEM</b>	Mid-Atlantic/New England/Maritimes (Waterbird Conservation Plan)
<b>MPA</b>	Marine Protected Area
<b>MOA</b>	Memorandum of Agreement
<b>MOU</b>	Memorandum of Understanding
<b>NAAMP</b>	North American Amphibian Monitoring Program
<b>NABCI</b>	North American Bird Conservation Initiative
<b>NAWCP</b>	North American Waterbird Conservation Plan
<b>NAWMP</b>	North American Waterfowl Management Plan
<b>NEFO</b>	New England Field Office
<b>NEPA</b>	National Environmental Policy Act of 1969
<b>NH</b>	New Hampshire
<b>NHB</b>	New Hampshire Natural Heritage Bureau
<b>NHDES</b>	New Hampshire Department of Environmental Services
<b>NHFG</b>	New Hampshire Fish and Game Department
<b>NHOEP</b>	New Hampshire Office of Energy and Planning
<b>NH WAP</b>	New Hampshire Wildlife Action Plan
<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>NWPS</b>	National Wilderness Preservation System
<b>NWR</b>	National Wildlife Refuge
<b>NWRS</b>	National Wildlife Refuge System
<b>OMWM</b>	Open Marsh Water Management
<b>PAL</b>	The Public Archaeological Laboratory, Inc



<b>PARC</b>	Partners in Amphibian and Reptile Conservation
<b>PDA</b>	Pease Development Authority
<b>PIF</b>	Partners in Flight
<b>PPP</b>	Preliminary project proposal
<b>PREP</b>	Piscataqua Region Estuaries Partnership
<b>PSNH</b>	Public Service of New Hampshire
<b>RONS</b>	Refuge Operations Needs System
<b>RV</b>	Recreational Vehicle
<b>SAMMS</b>	(USFWS) Service Asset Maintenance Management System
<b>SAV</b>	Submerged aquatic vegetation
<b>SCEP</b>	Student Career Experience Program
<b>SEED</b>	Safety Evaluation of Existing Dams report
<b>SET</b>	Sea Elevation Table
<b>SHPO</b>	State Historic Preservation Office
<b>SLAMM</b>	Sea-level affecting marshes model
<b>SPNHF</b>	Society for the Protection of New Hampshire Forests
<b>STEP</b>	Student Temporary Employment Program
<b>SWG</b>	State wildlife grant
<b>TNC</b>	The Nature Conservancy
<b>TPL</b>	Trust for Public Land
<b>UNH</b>	University of New Hampshire
<b>USDA</b>	U.S. Department of Agriculture
<b>USEPA, EPA</b>	U.S. Environmental Protection Agency
<b>USFWS, Service</b>	U.S. Fish and Wildlife Service
<b>USGS</b>	U.S. Geological Survey
<b>VOC</b>	Volatile organic compound
<b>WIA</b>	Wilderness Inventory Area
<b>WMA</b>	Wildlife Management Area
<b>WMU</b>	Wildlife Management Unit
<b>YCC</b>	Youth Conservation Corps

## List of Species and Their Scientific Names

Common Name	Scientific Name
Alder species	<i>Alnus</i> spp.
Alewife	<i>Alosa pseudoharengus</i>
American beech	<i>Fagus grandifolia</i>
American bittersweet	<i>Celastrus scandens</i>
American black bear	<i>Ursus americanus</i>
American black duck	<i>Anas rubripes</i>
American bullfrog	<i>Lithobates catesbeiana</i>
American chestnut	<i>Castanea dentata</i>
American coot	<i>Fulica americana</i>
American crow	<i>Corvus brachyrhynchos</i>
American eel	<i>Anguilla rostrata</i>
American goldfinch	<i>Spinus tristis</i>
American hazelnut	<i>Corylus americana</i>
American kestrel	<i>Falco sparverius</i>
American redstart	<i>Setophaga ruticilla</i>
American robin	<i>Turdus migratorius</i>
American shad	<i>Alosa sapidissima</i>
American toad	<i>Anaxyrus americanus</i>
American wigeon	<i>Anas americana</i>
American woodcock	<i>Scolopax minor</i>
Amur honeysuckle	<i>Lonicera maaackii</i>
Arctic tern	<i>Sterna paradisaea</i>
Arrowhead	<i>Sagittaria</i> spp.
Arrowwood	<i>Viburnum dentatum</i>
Asian long-horned beetle	<i>Anoplophora glabripennis</i>
Atlantic salmon	<i>Salmo salar</i>
Atlantic silverside	<i>Menidia menidia</i>
Autumn olive	<i>Elaeagnus umbellata</i>
Bald eagle	<i>Haliaeetus leucocephalus</i>
Baltimore oriole	<i>Icterus galbula</i>
Banded killifish	<i>Fundulus diaphanus</i>
Barn swallow	<i>Hirundo rustica</i>
Bayberry	<i>Myrica pennsylvanica</i>
Beaver	<i>Castor canadensis</i>
Beech species	<i>Fagus</i> spp.
Big bluestem	<i>Andropogon gerardii</i>
Big brown bat	<i>Eptesicus fuscus</i>
Birch species	<i>Betula</i> spp.
Birdfoot violet	<i>Viola pedata</i>
Black and white warbler	<i>Mniotilta varia</i>
Black cherry	<i>Prunus serotina</i>
Black gum	<i>Nyssa sylvatica</i>
Black huckleberry	<i>Gaylussacia baccata</i>

<b>Common Name</b>	<b>Scientific Name</b>
Black locust	<i>Robinia pseudoacacia</i>
Black oak	<i>Quercus velutina</i>
Black racer	<i>Coluber constrictor constrictor</i>
Black sedge	<i>Scirpus nigra</i>
Black swallow-wort	<i>Cynanchum louiseae</i>
Black throated green warbler	<i>Setophaga virens</i>
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>
Black-capped chickadee	<i>Poecile atricapillus</i>
Black-grass	<i>Juncus gerardii</i>
Blanding's turtle	<i>Emydoidea blandingii</i>
Blue jay	<i>Cyanocitta cristata</i>
Blue mussels	<i>Mytilus edulis</i>
Blueback herring	<i>Alosa aestivalis</i>
Blueberry species	<i>Vaccinium spp.</i>
Bluefish	<i>Pomatomus saltatrix</i>
Blue-spotted salamander	<i>Ambystoma laterale</i>
Blue-winged warbler	<i>Vermivora cyanoptera</i>
Blunt-leaved milkweed	<i>Asclepias amplexicaulis</i>
Bobolink	<i>Dolichonyx oryzivorus</i>
Border privet	<i>Ligustrum obtusifolium</i>
Brittle waternymph	<i>Najas minor</i>
Brook trout	<i>Salvelinus fontinalis</i>
Brown bullhead	<i>Ameiurus nebulosus</i>
Brown creeper	<i>Certhia americana</i>
Brown thrasher	<i>Toxostoma rufum</i>
Brown-headed cowbird	<i>Molothrus ater</i>
Bufflehead	<i>Bucephala albeola</i>
Canada goose	<i>Branta canadensis</i>
Canada lynx	<i>Lynx canadensis</i>
Canada thistle	<i>Cirsium arvense</i>
Caribou	<i>Rangifer tarandus</i>
Carolina wren	<i>Thryothorus ludovicianus</i>
Cattail species	<i>Typha spp.</i>
Cedar waxwing	<i>Bombycilla cedrorum</i>
Chain pickerel	<i>Esox niger</i>
Chestnut blight	<i>Cryphonectria parasitica</i>
Chestnut sided warbler	<i>Setophaga pensylvanica</i>
Chimney swift	<i>Chaetura pelagica</i>
Chipping sparrow	<i>Spizella passerina</i>
Climbing nightshade	<i>Solanum dulcamara</i>
Coltsfoot	<i>Tussilago farfara</i>
Common barberry	<i>Berberis vulgaris</i>
Common buckthorn	<i>Rhamnus cathartica</i>
Common gallinule	<i>Gallinula galeata</i>

*List of Species and Their Scientific Names*

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<b>Common Name</b>	<b>Scientific Name</b>
Common garter snake	<i>Thamnophis sirtalis</i>
Common grackle	<i>Quiscalus quiscula</i>
Common juniper	<i>Juniperus communis</i>
Common merganser	<i>Mergus merganser</i>
Common mullein	<i>Verbascum thapsus</i>
Common nighthawk	<i>Chordeiles minor</i>
Common raven	<i>Corvus corax</i>
Common tern	<i>Sterna hirundo</i>
Common yellowthroat	<i>Geothlypis trichas</i>
Coyote	<i>Canis latrans</i>
Creeping buttercup	<i>Ranunculus repens</i>
Creeping jenny	<i>Lysimachia nummularia</i>
Dames rocket	<i>Hesperis matronalis</i>
Dickcissel	<i>Spiza americana</i>
Dogwood species	<i>Cornus</i> spp.
Downy woodpecker	<i>Picoides pubescens</i>
Eastern cottontail	<i>Sylvilagus floridanus</i>
Eastern hemlock	<i>Tsuga canadensis</i>
Eastern kingbird	<i>Tyrannus tyrannus</i>
Eastern meadowlark	<i>Sturnella magna</i>
Eastern phoebe	<i>Sayornis phoebe</i>
Eastern red bat	<i>Lasiurus borealis</i>
Eastern red cedar	<i>Juniperus virginiana</i>
Eastern small-footed bat	<i>Myotis leibii</i>
Eastern towhee	<i>Pipilo erythrophthalmus</i>
Eastern wood pewee	<i>Contopus virens</i>
Eelgrass	<i>Zostera marina</i>
Elderberry species	<i>Sambucus</i> spp.
Elk	<i>Cervus canadensis</i>
Elm species	<i>Ulmus</i> spp.
Emerald ash borer	<i>Agrilus planipennis</i>
European privet	<i>Ligustrum vulgare</i>
European starling	<i>Sturnus vulgaris</i>
Fairy shrimp	<i>Eubrachipus</i> spp.
Fern-leaved foxglove	<i>Aureolaria pedicularia</i> var. <i>intercedens</i>
Field sparrow	<i>Spizella pusilla</i>
Fir species	<i>Abies</i> spp.
Fisher	<i>Martes pennanti</i>
Flowering dogwood	<i>Cornus florida</i>
Frosted elfin butterfly	<i>Callophrys irus</i>
Glossy buckthorn	<i>Frangula alnus</i>
Glossy ibis	<i>Plegadis falcinellus</i>
Golden heather	<i>Hudsonia ericoides</i>

Common Name	Scientific Name
Golden shiner	<i>Notemigonus crysoleucas</i>
Grasshopper sparrow	<i>Ammodramus savannarum</i>
Gray catbird	<i>Dumetella carolinensis</i>
Gray squirrel	<i>Sciurus carolinensis</i>
Gray treefrog	<i>Hyla versicolor</i>
Gray wolf	<i>Canis lupus</i>
Great auk	<i>Pinguinus impennis</i>
Great blue heron	<i>Ardea herodias</i>
Great crested flycatcher	<i>Myiarchus crinitus</i>
Greater celandine	<i>Chelidonium majus</i>
Greater scaup	<i>Aythya marila</i>
Green crab	<i>Carcinus maenas</i>
Green frog	<i>Lithobates clamitans</i>
Green-winged teal	<i>Anas crecca</i>
Ground ivy	<i>Glechoma hederacea</i>
Hairy bedstraw	<i>Galium pilosum</i>
Hairy hudsonia	<i>Hudsonia tomentosa</i>
Hairy woodpecker	<i>Myiarchus crinitus</i>
Heath hen	<i>Tympanuchus cupido cupido</i>
Hemlock wooly adelgid	<i>Adelges tsugae</i>
Highbush blueberry	<i>Vaccinium corymbosum</i>
Hoary bat	<i>Lasiurus cinereus</i>
Hognose snake	<i>Heterodon platirhinos</i>
Honeysuckle species	<i>Lonicera</i> spp.
Horned lark	<i>Eremophila alpestris</i>
Horseshoe crab	<i>Limulus polyphemus</i>
Horsetail	<i>Equisetum sylvaticum</i>
House finch	<i>Carpodacus mexicanus</i>
Indiana bat	<i>Myotis sodalis</i>
Indigo bunting	<i>Passerina cyanea</i>
Japanese barberry	<i>Berberis thunbergii</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
Japanese knotweed	<i>Polygonum cuspidatum</i>
Japanese wisteria	<i>Wisteria floribunda</i>
Karner blue butterfly	<i>Lycaedes melissa samuelis</i>
Killdeer	<i>Charadrius vociferus</i>
King rail	<i>Rallus elegans</i>
Labrador duck	<i>Camptorhynchus labradorius</i>
Ladyfern	<i>Athyrium filix-femina</i>
Large bur-reed	<i>Sparganium eurycarpum</i>
Largemouth bass	<i>Micropterus salmoides</i>
Leafy spurge	<i>Euphorbia esula</i>
Least bittern	<i>Ixobrychus exilis</i>



Common Name	Scientific Name
Lesser scaup	<i>Aythya affinis</i>
Little bluestem	<i>Schizachyrium scoparium</i>
Little brown bat	<i>Myotis lucifugus</i>
Lowbush blueberry	<i>Vaccinium angustifolium</i>
Mallard	<i>Anas platyrhynchos</i>
Maple species	<i>Acer</i> spp.
Marsh marigold	<i>Caltha palustris</i>
Marsh wren	<i>Cistothorus palustris</i>
Maryland tick-trefoil	<i>Desmodium marilandicum</i>
Meadowsweet	<i>Spiraea alba</i>
Moose	<i>Alces alces</i>
Morrow's honeysuckle	<i>Lonicera morrowii</i>
Mountain laurel	<i>Kalmia latifolia</i>
Mountain lion	<i>Puma concolor</i>
Mourning dove	<i>Zenaida macroura</i>
Mullein	<i>Verbascum thapsus</i>
Mummichog minnow	<i>Fundulus heteroclitus</i>
Musclewood	<i>Carpinus caroliniana</i>
Muskrat	<i>Ondatra zibethicus</i>
Mute swan	<i>Cygnus olor</i>
Narrow-leaf cattail	<i>Typha angustifolia</i>
Nelson's sharp-tailed sparrow	<i>Ammodramus nelsoni</i>
New England cottontail	<i>Sylvilagus transitionalis</i>
New Jersey tea	<i>Ceanothus americanus</i>
Nine-spined stickleback	<i>Pungitius pungitius</i>
Northern blazing-star	<i>Liatris borealis</i>
Northern brown snake	<i>Storeria dekayi dekayi</i>
Northern cardinal	<i>Cardinalis cardinalis</i>
Northern flicker	<i>Colaptes auratus</i>
Northern leopard frog	<i>Lithobates pipens</i>
Northern mockingbird	<i>Mimus polyglottos</i>
Northern myotis	<i>Myotis septentrionalis</i>
Northern red-bellied snake	<i>Storeria occipitomaculata occipitomaculata</i>
Northern short-tailed shrew	<i>Blarina brevicauda</i>
Oak species	<i>Quercus</i> spp.
Oriental bittersweet	<i>Celastrus orbiculata</i>
Osprey	<i>Pandion haliaetus</i>
Ovenbird	<i>Seiurus aurocapilla</i>
Oyster	<i>Crassostrea virginica</i>
Oysters	<i>Crassostrea virginica</i>
Painted turtle	<i>Chrysemys picta</i>
Paper birch	<i>Betula papyrifera</i>

Common Name	Scientific Name
Passenger pigeon	<i>Ectopistes migratorius</i>
Pennsylvania sedge	<i>Carex pensylvanica</i>
Persius duskywing skipper	<i>Erynnis persius persius</i>
<i>Phragmites</i> (common reed)	<i>Phragmites australis</i>
Pickerel frog	<i>Lithobates palustris</i>
Pied-billed grebe	<i>Podilymbus podiceps</i>
Pignut hickory	<i>Carya glabra</i>
Pileated woodpecker	<i>Dryocopus pileatus</i>
Pine species	<i>Pinus</i> spp.
Pine warbler	<i>Setophaga pinus</i>
Pitch pine	<i>Pinus rigida</i>
Prairie warbler	<i>Setophaga discolor</i>
Prostrate tick-trefoil	<i>Desmodium rotundifolium</i>
Purple loosestrife	<i>Lythrum salicaria</i> L.
Purple martin	<i>Progne subis</i>
Rainbow smelt	<i>Osmerus mordax</i>
Rainbow trout	<i>Oncorhynchus mykiss</i>
Raspberry	<i>Rubus</i> spp.
Red eyed vireo	<i>Vireo olivaceus</i>
Red fox	<i>Vulpes vulpes</i>
Red maple	<i>Acer rubrum</i>
Red oak	<i>Quercus rubra</i>
Red pine	<i>Pinus resinosa</i>
Red-backed salamander	<i>Plethodon cinereus</i>
Red-winged blackbird	<i>Agelaius phoeniceus</i>
Reed canarygrass	<i>Phalaris arundinacea</i>
Reflexed sedge	<i>Carex retroflexa</i>
Ring-necked duck	<i>Aythya collaris</i>
River otter	<i>Lontra canadensis</i>
Roseate tern	<i>Sterna dougallii</i>
Rose-breasted grosbeak	<i>Pheucticus ludovicianus</i>
Ruddy duck	<i>Oxyura jamaicensis</i>
Ruffed grouse	<i>Bonasa umbellus</i>
Rugosa rose	<i>Rosa rugosa</i>
Salt marsh sparrow	<i>Ammodramus caudacutus</i>
Salt meadow cordgrass	<i>Spartina patens</i>
Sand shrimp	<i>Crangon septemspinosa</i>
Savannah sparrow	<i>Passerculus sandwichensis</i>
Scarlet tanager	<i>Piranga olivacea</i>
Scotch pine	<i>Pinus sylvestris</i>
Scrub oak (bear oak)	<i>Quercus ilicifolia</i>
Sea mink	<i>Neovison macrodon</i>
Seaside goldenrod	<i>Solidago sempervirens</i>

Common Name	Scientific Name
Seaside mallow	<i>Hibiscus moscheutos</i>
Sedge species	<i>Scirpus</i> spp.
Sensitive fern	<i>Onoclea sensibilis</i>
Shagbark hickory	<i>Carya ovata</i>
Sheep sorrel	<i>Rumex acetosella</i>
Shore shrimp	<i>Paleomonetes vulgaris</i>
Silky dogwood	<i>Cornus amomum</i>
Slender knotweed	<i>Polygonum tenue</i>
Smooth alder	<i>Alnus serrulata</i>
Smooth cordgrass	<i>Spartina alterniflora</i>
Smooth green snake	<i>Opheodrys vernalis</i>
Snapping turtle	<i>Chelydra serpentina</i>
Softstem bulrush	<i>Schoenoplectus tabernaemontani</i>
Song sparrow	<i>Melospiza melodia</i>
Sora rail	<i>Porzana carolina</i>
Speckled alder	<i>Alnus rugosa</i>
Spicebush	<i>Lindera benzoin</i>
Spike grass	<i>Distichlis spicata</i>
Spotted knapweed	<i>Centaurea maculosa</i>
Spotted salamander	<i>Plethodon cinereus</i>
Spotted turtle	<i>Clemmys guttata</i>
Spreading dogbane	<i>Apocynum androsaemifolium</i>
Spring peeper	<i>Pseudacris crucifer</i>
Spruce species	<i>Picea</i> spp.
Stout bulrush	<i>Schoenoplectus robustus</i>
Striped bass	<i>Morone saxatilis</i>
Sturgeon	<i>Acipenser</i> spp.
Sugar maple	<i>Acer saccharum</i>
Sumac species	<i>Rhus</i> spp.
Sunfish	<i>Lepomis macrochirus</i>
Sweet goldenrod	<i>Solidago odora</i>
Tree swallow	<i>Tachycineta bicolor</i>
Tufted titmouse	<i>Baeolophus bicolor</i>
Tussock sedge	<i>Carex stricta</i>
Upland sandpiper	<i>Bartramia longicauda</i>
Veery	<i>Catharus fuscescens</i>
Vesper sparrow	<i>Pooecetes gramineus</i>
Virginia opossum	<i>Didelphis virginiana</i>
Virginia rail	<i>Rallus limicola</i>
Warbling vireo	<i>Vireo gilvus</i>
Wasting disease/slime mold	<i>Labryrinthula zosterae</i>
Whip-poor-will	<i>Caprimulgus vociferus</i>
White ash	<i>Fraxinus americana</i>

Common Name	Scientific Name
White fir	<i>Abies concolor</i>
White oak	<i>Quercus alba</i>
White pine	<i>Pinus strobus</i>
White spruce	<i>Picea glauca</i>
White-breasted nuthatch	<i>Sitta carolinensis</i>
White-nose syndrome fungus	<i>Geomyces destructans</i>
White-tailed deer	<i>Odocoileus virginianus</i>
Wigeongrass	<i>Ruppia maritima</i>
Wild celery	<i>Apium graveolens</i>
Wild lupine	<i>Lupinus perennis</i>
Wild rice	<i>Zizania aquatica</i>
Wild turkey	<i>Meleagris gallopavo</i>
Wild turkey	<i>Meleagris gallopavo</i>
Willet	<i>Tringa semipalmata</i>
Willow flycatcher	<i>Empidonax traillii</i>
Winged euonymus	<i>Euonymus alatus</i>
Winterberry	<i>Ilex verticillata</i>
Wolverine	<i>Gulo gulo</i>
Wood duck	<i>Aix sponsa</i>
Wood frog	<i>Lithobates sylvaticus</i>
Wood thrush	<i>Hylocichla mustelina</i>
Yellow perch	<i>Perca flavescens</i>
Yellow-rumped warbler	<i>Setophaga coronata</i>

## Appendix A

Thomas Barnes/USFWS



*Bald eagle*

## **Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay Refuge and Karner Blue Butterfly Conservation Easement**



Table A.1. Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay Refuge.

Species	Seasons on Refuge <sup>1</sup>	Federal Threatened & Endangered Species <sup>2</sup>	NH State Threatened & Endangered Species <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 9 <sup>5</sup>	USFWS Birds of Conservation Concern <sup>6</sup>	Federal Trust Fish Species Trend Data <sup>7</sup>	Species of Regional Conservation Concern <sup>8</sup>	Northern Atlantic Regional Shorebird Plan <sup>9</sup>	North American Waterbird Plan <sup>10</sup>	North American Waterfowl Plan <sup>11</sup>	NH Wildlife Action Plan <sup>12</sup>
<b>WATERBIRDS</b>												
American bittern	M			M		X		X		H		X
Great blue heron	B, M											X
King rail	M			M						H		
Least bittern	B, M		SC	M		X				H		X
Pied-billed grebe	B, M		T			X				H		X
Snowy egret	M			M		X				H		
<b>WATERFOWL</b>												
American black duck	B, M, W			HH	2C						D	X
Atlantic Population Canada goose	B, M			HH							I	
Bufflehead	M			H							I	
Common eider	M			H							D	
Common goldeneye	M			M							NT	
Greater scaup	M			H							NT	
Hooded merganser	B, M			M							I	
Lesser scaup	M			H							D	
Mallard	B			H							NT	
Red-breasted merganser	M			M							I	
Wood duck	B, M			M							I	
<b>SHOREBIRDS</b>												
American woodcock	B, M			HH	1A				5			X
Common snipe	M			M					3			
Common tern	B, M		T	M						L		X
Dunlin	M			H					3			
Greater yellowlegs	M			H					4			
Killdeer	B, M			M					2			
Least sandpiper	M			M					3			

Species	Seasons on Refuge <sup>1</sup>	Federal Threatened & Endangered Species <sup>2</sup>	NH State Threatened & Endangered Species <sup>3</sup>	BCR 30 <sup>4</sup>	PIF9 <sup>5</sup>	USFWS Birds of Conservation Concern <sup>6</sup>	Federal Trust Fish Species Trend Data <sup>7</sup>	Species of Regional Conservation Concern <sup>8</sup>	Northern Atlantic Regional Shorebird Plan <sup>9</sup>	North American Waterbird Plan <sup>10</sup>	North American Waterfowl Plan <sup>11</sup>	NH Wildlife Action Plan <sup>12</sup>
<b>SHOREBIRDS (cont.)</b>												
Lesser yellowlegs	M			M		X			2			
Red knot	M			HH		X		X	5			
Sanderling	M			HH					4			
Semipalmated plover	M			M					2			
Semipalmated sandpiper	M			H		X			4			X
Short-billed dowitcher	M			H		X			3			
Solitary sandpiper	M			H		X			3			
Spotted sandpiper	B, M			M					3			
Upland sandpiper	B, M		E	M	1B	X		X	4			X
Whimbrel	M			HH		X			5			
White-rumped sandpiper	M			H					3			
Willet	B, M		SC	H					4			X
<b>LANDBIRDS</b>												
American kestrel	B, M		SC									
Bald eagle	W, YR		T	M		X						X
Baltimore oriole	B, M			H	1A							
Black-and-white warbler	B, M			H	2A							
Black-billed cuckoo	B, M				1A							
Black-throated blue warbler	M				1B							
Blue-winged warbler	B, M			HH	1A	X						
Broad-winged hawk	M			H								
Brown thrasher	B, M			H								
Chimney swift	M			H	2A							
Common nighthawk	B, M		E									X
Cooper's hawk	M											X
Eastern kingbird	B, M			H								
Eastern meadowlark	B, M		SC									X

Species	Seasons on Refuge <sup>1</sup>	Federal Threatened & Endangered Species <sup>2</sup>	NH State Threatened & Endangered Species <sup>3</sup>	BCR 30 <sup>4</sup>	PIF9 <sup>5</sup>	USFWS Birds of Conservation Concern <sup>6</sup>	Federal Trust Fish Species Trend Data <sup>7</sup>	Species of Regional Conservation Concern <sup>8</sup>	Northern Atlantic Regional Shorebird Plan <sup>9</sup>	North American Waterbird Plan <sup>10</sup>	North American Waterfowl Plan <sup>11</sup>	NH Wildlife Action Plan <sup>12</sup>
<b>LANDBIRDS (cont.)</b>												
Eastern towhee	B, M			H	2A							X
Field sparrow	B, M			H								
Golden-winged warbler	M		SC	M	1B	X						X
Grasshopper sparrow	M		T	M								X
Great-crested flycatcher	B, M			H								
Louisiana waterthrush	M			H	1A			X				
Marsh wren	B, M			H								
Nelson's sparrow	B, M		SC	M	1B	X						X
Northern flicker	B, M			H								
Northern harrier	M		E					X				X
Osprey	B, M		SC									X
Peregrine falcon	M		T		2C	X						X
Prairie warbler	B, M			HH	1A	X						
Purple martin	M		SC									X
Red-shouldered hawk	M											X
Rose-breasted grosbeak	M				2A							
Salt marsh sparrow	B, M		SC	HH	1A	X		X				X
Scarlet tanager	B, M				1A							
Seaside sparrow	M		SC	HH	1A	X						X
Sedge wren	M		E	M	2C	X		X				X
Short-eared owl	M			M	2C	X						
Veery	M											X
Willow flycatcher	B, M			H								
Wood thrush	B, M			HH	1A	X						X
Yellow-throated vireo	B, M			H								

Species	Seasons on Refuge <sup>1</sup>	Federal Threatened & Endangered Species <sup>2</sup>	NH State Threatened & Endangered Species <sup>3</sup>	BCR 30 <sup>4</sup>	PIF9 <sup>5</sup>	USFWS Birds of Conservation Concern <sup>6</sup>	Federal Trust Fish Species Trend Data <sup>7</sup>	Species of Regional Conservation Concern <sup>8</sup>	Northern Atlantic Regional Shorebird Plan <sup>9</sup>	North American Waterbird Plan <sup>10</sup>	North American Waterfowl Plan <sup>11</sup>	NH Wildlife Action Plan <sup>12</sup>
<b>MAMMALS</b>												
Bobcat												X
Big brown bat												
Eastern red bat			SC					X				X
Eastern small-footed bat	B, M		E					X				X
Hoary bat			SC					X				X
Little brown bat	M											
New England cottontail		C	E									X
Northern myotis	B, M		SC									X
Silver-haired bat			SC					X				X
<b>AMPHIBIANS</b>												
Blue-spotted salamander			SC					X				X
Fowler's toad			SC									X
Marbled salamander			E									X
Northern leopard frog			SC					X				X
<b>REPTILES</b>												
Blanding's turtle			E					X				X
Eastern ribbon snake								X				X
Smooth green snake			SC									X
Spotted turtle			T					X				X
Wood turtle			SC					X				X
<b>FISH</b>												
Alewife		C/SoC	SC				D					X
American eel			SC				D					X
American shad			SC				D					X
Atlantic sturgeon*		T					D					X
Blueback herring		C/SoC	SC				D					X
Brindle shiner			T									X
Swamp darter			SC									X
Rainbow smelt		SoC	SC									X

Species	Seasons on Refuge <sup>1</sup>	Federal Threatened & Endangered Species <sup>2</sup>	NH State Threatened & Endangered Species <sup>3</sup>	BCR 30 <sup>4</sup>	PIF 9 <sup>5</sup>	USFWS Birds of Conservation Concern <sup>6</sup>	Federal Trust Fish Species Trend Data <sup>7</sup>	Species of Regional Conservation Concern <sup>8</sup>	Northern Atlantic Regional Shorebird Plan <sup>9</sup>	North American Waterbird Plan <sup>10</sup>	North American Waterfowl Plan <sup>11</sup>	NH Wildlife Action Plan <sup>12</sup>
<b>PLANTS</b>												
Northern blazing star ( <i>Liatris borealis</i> )			E									X
Large bur-reed ( <i>Sparganium eurycarpum</i> )			T									X
Seaside mallow ( <i>Hibiscus moscheutos</i> )			E									X
Goodenough's sedge ( <i>Carex nigra</i> )			E									X
Blunt-leaved milkweed ( <i>Asclepias amplexicaulis</i> )			T									X
Golden heather ( <i>Hudsonia ericoides</i> L.)			E									X

<sup>1</sup>Seasons on the refuge (Birds): B=Breeding, W=Wintering, M=Migration, YR=Year-round. Sources: (Mirck 1993) and unpublished Great Bay National Wildlife Refuge observations.

<sup>2</sup>Federal List of Threatened and Endangered Species: T=Threatened, E=Endangered, C= Candidate, SoC=Species of Concern.

<sup>3</sup>New Hampshire State List of Threatened and Endangered Species: T=Threatened, E=Endangered, SC=Special Concern.

<sup>4</sup>New England/Mid-Atlantic Coast Bird Conservation Implementation Plan (Steinkamp 2008): HH=Highest Priority, H=High Priority, M=Moderate Priority.

<sup>5</sup>Partners in Flight Physiographic Area 9 (PIF 9) - Southern New England (Dettmers and Rosenberg 2000):  
1A= High Continental Priority–High Regional Responsibility, 1B= High Continental Priority–Low Regional Responsibility,  
2A= High Regional Concern, 2B= High Regional Responsibility, 2C=High Regional Threats, 3= Additional Watch List.

<sup>6</sup>U.S. Fish and Wildlife Service - Birds of Conservation Concern 2008 (USFWS 2008): X= Species of Conservation Concern for BCR 30.

<sup>7</sup>Federal Trust Fish Species USFWS Population Trend Data: I=increasing, D=decreasing.

<sup>8</sup>Species of Regional Conservation Concern (NETC 1999): X= Wildlife species of regional conservation concern in the Northeastern United States.

<sup>9</sup>Northern Atlantic Regional Shorebird Plan (Clark and Niles 2000): 5=Highly Imperiled, 4= Species of High Concern, 3=Species of Moderate Concern, 2=Species of Low Concern, 1=Species Not at Risk. For each species, we list the national priority, except where the Northern Atlantic regional priority is different. In those cases, we list the regional priority instead.

<sup>10</sup>North American Waterbird Plan (Kushlan et al. 2002): H=High Risk, M=Moderate Risk, L=Low Risk.

<sup>11</sup>North American Waterfowl Management Plan (CWS, USFWS, and SEMARNAT 2004): Population Trends: I=Increasing, D=Decreasing, NT=No Trend.

<sup>12</sup>New Hampshire Wildlife Action Plan (NHFG 2005): X= Species of Greatest Conservation Need.

\*Occurs in Great Bay Estuary; off-refuge.



**Table A.2. Species and Habitats of Concern Known, or Potentially Occurring, on the Karner Blue Butterfly Conservation Easement in Concord, New Hampshire**

Common Name		Federal Threatened & Endangered Species <sup>1</sup>	NH State Threatened & Endangered Species <sup>2</sup>	BCR 30 <sup>3</sup>	NH Wildlife Action Plan <sup>4</sup>
<b>Birds</b>					
Common nighthawk	<i>Chordeiles minor</i>		E		X
Eastern towhee	<i>Pipilo erythrophthalmus</i>			H	X
Grasshopper sparrow	<i>Ammodramus savannarum</i>		T	M	X
Whip-poor-will	<i>Caprimulgus vociferous</i>		SC	H	X
<b>Amphibians</b>					
Fowler's toad	<i>Bufo woodhousii fowleri</i>		SC		X
<b>Reptiles</b>					
Black racer	<i>Coluber constrictor</i>		T		X
Hognose snake	<i>Heterodon platirhinos</i>		E		X
Smooth green snake	<i>Opheodrys vernalis</i>		SC		X
<b>Invertebrates</b>					
Barrens xylotype	<i>Xylotype capax</i>		SC		X
Broad-lined catopyrrha	<i>Catopyrrha coloraria</i>		SC		X
Cora moth	<i>Cerma cora</i>		SC		X
Frosted elfin butterfly	<i>Callophrys irus</i>		E		X
Karner blue butterfly	<i>Lycaeides melissa samuelis</i>	E	E		X
Persius duskywing	<i>Erynnis persius persius</i>		E		X
Phyllira tiger moth	<i>Grammia phyllira</i>		SC		X
Pine barrens itame	<i>Itame sp. 1</i>		SC		X
Pine barrens zanclognatha moth	<i>Zanclognatha martha</i>		SC		X
Sleepy duskywing	<i>Erynnis brizo brizo</i>		SC		X
<b>PLANTS</b>					
Wild lupine	<i>Lupinus perennis</i>	T	T		X

<sup>1</sup>Federal List of Threatened and Endangered Species: T=Threatened, E=Endangered, C= Candidate, SoC=Species of Concern.

<sup>2</sup>New Hampshire State List of Threatened and Endangered Species: T=Threatened, E=Endangered, SC=Special Concern.

<sup>3</sup>New England/Mid-Atlantic Coast Bird Conservation Implementation Plan (Steinkamp 2008): HH=Highest Priority, H=High Priority, M=Moderate Priority.

<sup>4</sup>New Hampshire Wildlife Action Plan (NHFG 2005): X= Species of Greatest Conservation Need.

**Table A.3. Priority Habitat Types and Their Associated Focal Species for Great Bay Refuge.**

<b>Priority Habitat Types</b>	<b>Associated Focal Species</b>
<b>Freshwater impoundments</b>	Marsh wren, migrating and wintering waterfowl, nesting marshbirds, alewife, blueback herring, American eel, giant bur-reed
<b>Intertidal Estuarine</b>	Eelgrass beds, oysters, alewife, blueback herring, American eel
<b>Salt marsh and rocky shoreline</b>	Wintering black duck, wintering bald eagle, foraging marsh and wading birds, migratory shorebirds, salt marsh sparrow, seaside mallow, American eel
<b>Forested and scrub-shrub wetlands and vernal pools</b>	Willow flycatcher, wood thrush, vernal pool obligate amphibians, foraging woodcock, and native plant communities
<b>Oak-hickory forest</b>	Wood thrush, scarlet tanager, Baltimore oriole, solitary tree bats
<b>Shrubland</b>	Eastern towhee, prairie warbler, blue-winged warbler, American woodcock, black racer, New England cottontail
<b>Grassland</b>	Upland sandpiper, American woodcock, Eastern meadowlark, New England blazing star

## **LITERATURE CITED**

- Canadian Wildlife Service, U.S. Fish and Wildlife Service, and Secretaría de Medio Ambiente y Recursos Naturales (CWS, USFWS, and SEMARNAT). 2004. North American Waterfowl Management Plan, Strengthening the Biological Foundation, 2004 Strategic Guidance. Accessed online October 2011 at: <http://www.fws.gov/birdhabitat/NAWMP/files/NAWMP2004.pdf>.
- Clark, K.E, and L.J. Niles. 2000. Northern Atlantic Regional Shorebird Plan, Version 1.0. Northern Atlantic Shorebird Habitat Working Group and the New Jersey Division of Fish and Wildlife, Endangered and Nongame Species Program. Woodbine, NJ. 28pp. Accessed online October 2011 at: <http://www.fws.gov/shorebirdplan/RegionalShorebird/downloads/NATLAN4.pdf>.
- Dettmers, R. and K.V. Rosenberg. 2000. Partners in Flight Landbird Conservation Plan: Physiographic Area 9: Southern New England, Version 1.0. 52 pp. Accessed online October 2011 at: [http://www.blm.gov/wildlife/plan/pl\\_09\\_10.pdf](http://www.blm.gov/wildlife/plan/pl_09_10.pdf).
- Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R. M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J. E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas. Washington, DC, U.S.A. Accessed online October 2011 at: <http://www.pwrc.usgs.gov/nawwcp/nawwcp.html>.
- Mirck S., Audubon Society of New Hampshire. 1993. A checklist to the birds of Great Bay. New Hampshire Fish and Game Department. Unpaginated. Jamestown, N.D: Northern Prairie Wildlife Research Center Home Page.
- New Hampshire Fish and Game Department. 2005. New Hampshire Wildlife Action Plan. October 1, 2005. Accessed online October 2011 at: [http://www.wildlife.state.nh.us/Wildlife/wildlife\\_plan.htm](http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm).
- Northeast Endangered Species and Wildlife Diversity Technical Committee (NETC). 1999. Wildlife species of regional conservation concern in the northeastern United States. *Northeast Wildlife* 54: 93-100.
- Steincamp, M. 2008. Mid-Atlantic/Southern New England Bird Conservation Region 30 Implementation Plan. Atlantic Coast Joint Venture, Laurel, Maryland. Accessed online October 2011 at: [http://www.acjv.org/BCR\\_30/BCR30\\_June\\_23\\_2008\\_final.pdf](http://www.acjv.org/BCR_30/BCR30_June_23_2008_final.pdf).
- U.S. Fish and Wildlife Service (USFWS). 2008. Birds of Conservation Concern. 93 pp. Accessed online October 2011 at: [http://library.fws.gov/bird\\_publications/bcc2008.pdf](http://library.fws.gov/bird_publications/bcc2008.pdf).

## Appendix B

Bill Thompson/USFWS



*Eastern towhee*

# Process for Establishing Refuge Focal Species and Priority Habitats for Great Bay National Wildlife Refuge

- Introduction
- Process Overview
- Literature Citations

## Introduction

Biological goals and objectives serve as the foundation for refuge Comprehensive Conservation Plans (CCPs) and Habitat Management Plans (HMPs). These goals and objectives guide all management decisions regarding species and habitats. Prior to drafting biological goals and objectives, each refuge first identifies the species of conservation concern and priority habitats that will be the focus of its management. This appendix details the process the Great Bay National Wildlife Refuge (Great Bay Refuge, refuge) CCP planning team (we) used to identify these priority resources of concern, and ultimately, the refuge focal species and the habitat management priorities to benefit these resources.

## Process Overview

We consulted many sources to determine the priority resources of concern for the refuge, including legal mandates, U.S. Fish and Wildlife Service (Service) policies, the refuge's establishing purposes, and a variety of national, regional, State, and local conservation plans. We also considered the refuge's geographic location, local site capabilities, species' relative abundance and distribution, and respective species status in national and regional conservation plans. Additionally, we determined the most important and effective ecological contribution the refuge could make to the Great Bay Estuary, the State of New Hampshire, the Gulf of Maine Ecosystem, and the National Wildlife Refuge System (Refuge System).

Using the factors outlined above, we created a list of priority species and habitats. After grouping the habitats into broad categories, we sorted priority species by habitat type. For each of these broad habitat category types, we also selected a focal species to guide habitat management and for monitoring purposes.

### 1) Collect Information and Data

#### 1.1) Refuge's Establishing Purposes, Legal Mandates, and U.S. Fish and Wildlife Service Policies

The process for selecting resources of concern was guided by the refuge's establishing purposes, legal mandates for the Refuge System, and Service policies.

##### ***Establishing Purposes:***

The purposes of Great Bay Refuge were defined in the land transfer that established the refuge in 1992, as follows:

- To encourage the natural diversity of plant, fish, and wildlife species within the refuge, and to provide for their conservation and management.
- To protect species listed as endangered or threatened or identified as candidates pursuant to the Endangered Species Act of 1973.
- To preserve and enhance the water quality of aquatic habitat within the refuge.
- To fulfill the international treaty obligations of the United States relating to fish and wildlife.

##### ***Legal Mandates:***

Chapter 1 of the CCP describes the legal mandates guiding the management of the Refuge System. The following legal mandates relate to the identification of priority resources of concern on a refuge.

1. The Emergency Wetlands Resources Act of 1986 (16 U.S.C. § 3901 (b))  
*"...for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions."*
2. The Migratory Bird Conservation Act (16 U.S.C. § 715d)  
*"...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."*



3. The Endangered Species Act of 1973, as amended (16 U.S.C. § 1531-154)

*“The Secretary of the Interior....is designated as the Management Authority and the Scientific Authority for the purposes of the Convention and the respective functions of each Authority shall be carried out through the United States Fish and Wildlife Service.”*

The Act also requires that

*“all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act.”*

4. Fish and Wildlife Act of 1956 (16 U.S.C. § 742 f(a)(4))

*“...for the development, advancement, management, conservation, and protection of fish and wildlife resources...”*

5. Refuge Recreation Act of 1962 (16 U.S.C. § 460k—460k-4)

*“...(2) the protection of natural resources, (3) the conservation of endangered species and threatened species...”*

6. Refuge System Improvement Act of 1997 (Section 4(a)(3))

*“(A) each refuge shall be managed to fulfill the Mission of the System, as well as the specific purposes for which that refuge was established...”*

The Improvement Act further states that

*“In administering the System, the Secretary shall...ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans...”*

Various legislative and administrative acts also entrust the conservation and protection of certain species and habitats to the Service, called “Federal trust resources.” These include migratory birds, interjurisdictional fish, federally listed threatened and endangered species, wetlands, and certain marine mammals.

**Service Policies:**

Policy on Biological Integrity, Diversity, and Environmental Health (601 FW 3.3)

This policy provides guidance on maintaining or restoring the biological integrity, diversity, and environmental health of the Refuge System (601 FW 3), including the protection of a broad spectrum of fish, wildlife, and habitat resources in the refuge ecosystems. The policy explains the relationships among refuge purposes, the Refuge System mission, and maintaining biological integrity, diversity, and environmental health as follows:

*“...each refuge will be managed to fulfill refuge purpose(s) as well as to help fulfill the [Refuge] System mission, and we will accomplish these purpose(s) and our mission by ensuring that the biological integrity, diversity, and environmental health of each refuge are maintained, and where appropriate, restored.” (601 FW 3.7B)*

The policy advocates for an integrated and holistic approach to maintaining and restoring biological integrity, diversity, and environmental health. The policy directs refuges to evaluate biological integrity, diversity, and environmental health at several scales:

- The local scale, such as removing dams to restore historic stream flows.
- The larger landscape scale, such as supporting population and habitats that have declined or been lost at from ecosystem.
- The national or international scale.

It also highlights the dynamic nature of historical natural processes, and emphasizes managing within a natural range of variability to allow species, genetic strains, and natural communities to evolve with

changing conditions. According to the policy, the highest measure of biological integrity, diversity, and environmental health is conserving intact, self-sustaining habitats and wildlife populations that existed during historic conditions.

The policy also provides the following guidance on how to implement it:

1. Identify the refuge purposes, legislative responsibilities, refuge role within the ecosystem, and Refuge System mission.
2. Assess the current status of biological integrity, diversity, and environmental health through baseline vegetation and population surveys, and any other necessary environmental studies.
3. Assess historic conditions and compare them to current conditions. This will provide a benchmark of comparison for the relative intactness of ecosystems' functions and processes. This assessment should include the opportunities and limitations to maintaining and restoring biological integrity, diversity, and environmental health.
4. Consider the refuge's importance to refuge, ecosystem, national, and international landscape scales of biological integrity, diversity, and environmental health. Also, identify the refuge's roles and responsibilities within the Regional and Refuge System administrative levels.
5. Consider the relationships among refuge purposes and biological integrity, diversity, and environmental health, and resolve conflicts among them.
6. Through the CCP process, interim management planning, or compatibility reviews, determine the appropriate management direction to maintain and, where appropriate, restore, biological integrity, diversity, and environmental health, while achieving refuge purpose(s).
7. Evaluate the effectiveness of our management by comparing results to desired outcomes. If the results of our management strategies are unsatisfactory, assess the causes of failure and adapt our strategies accordingly.

## **1.2) Matrix of *Potential* Resources of Concern Based on National, Regional, State, and Local Conservation Plans**

We generated an overall list of species and plant communities of conservation concern that were either known, or suspected, to occur on Great Bay Refuge using national, regional, State, and local conservation plans (appendix A, table A.1). The following is a complete listing of the sources we used to compile the lists of resources of concern:

- Bird Conservation Region (BCR) 30 Plan–New England/Mid-Atlantic Coast.
- Partners in Flight (PIF) Physiographic Area 9 (Southern New England) Plan.
- North American Waterfowl Management Plan.
- U.S. Shorebird Conservation Plan.
- North American Waterbird Conservation Plan.
- U.S. Fish and Wildlife Service Birds of Conservation Concern–List for BCR 30.
- Federal List of Threatened and Endangered Species.
- New Hampshire State Comprehensive Wildlife Conservation Plan.
- New Hampshire Natural Heritage Bureau (NHB)–State List of Threatened and Endangered Species.
- Natural Communities of New Hampshire.
- New Hampshire Natural Heritage Inventory.
- Piscataqua Region Comprehensive Conservation and Management Plan (2010).
- Northeast States Nongame Technical Committee List of Species of Special Concern.

### 1.3) Identify Elements of Biological Integrity, Diversity, and Environmental Health

To identify the elements of biological integrity, diversity, and environmental health for Great Bay Refuge, we reviewed the historical conditions, site capability, current regional landscape conditions, and biological diversity for the refuge. The major sources we consulted included the following:

- Soils Map—U.S. Department of Agriculture Natural Resources Conservation Service Soil Types National Ecological Land Units Map.
- Kuchler’s Potential Natural Vegetation Map.
- Current Vegetation Map for Great Bay Refuge—National Vegetation Classification System.
- Historical and Current Wetlands Inventory Map.
- Historical topographic and hydrological maps.
- Historical aerial photography.
- Record of land management under Pease Airport (documented habitat alterations).
- NHB Natural Communities distribution maps.
- New Hampshire State Comprehensive Wildlife Conservation Plan.
- Consultation with The Nature Conservancy.
- Consultation of NHB natural community expert.
- Targeted field investigations (e.g., tree coring of various pine groves to ascertain origin and history).

We developed the following table (B.1) to help assess the biological integrity, diversity, and environmental health elements for the existing habitats at Great Bay Refuge.

**Table B.1. Biological Integrity, Diversity, and Environmental Health Elements for Great Bay Refuge**

<b>Plant Community</b>	<b>Population/Habitat Attributes (Soils, Structure, Species Composition)</b>	<b>Natural Processes/Limiting Factor</b>
Dry Appalachian oak-hickory forest	Oaks ( <i>Quercus velutina</i> , <i>Q. coccinea</i> , <i>Q. alba</i> , <i>Q. prinus</i> , <i>Q. ruba</i> ), hickories ( <i>Carya ovata</i> , <i>C. ovalis</i> , <i>C. glabra</i> ), and white pine ( <i>Pinus strobus</i> ) dominated canopy. Shrub layer dominated by flowering dogwood ( <i>Cornus florida</i> ), mountain laurel ( <i>Kalmia latifolia</i> ) and American hazelnut ( <i>Corylus americana</i> ). Oak sedge ( <i>Carex pensylvanica</i> ) may form extensive “lawns.” High diversity of herbaceous species, including numerous State rare species: common goldenrod ( <i>Solidago odora</i> ), birdfoot violet ( <i>Viola pedata</i> ), hairy bedstraw ( <i>Galium pilosum</i> ), fernleaf yellow false foxglove ( <i>Aureolaria pedicularia</i> ), reflexed sedge ( <i>Carex retroflexa</i> ), peatleaf knotweed ( <i>Polygonum tenue</i> ), <i>Tephrosia virginiana</i> , smooth small-leaf ticktrefoil ( <i>Desmodium marilandicum</i> ), prostrate ticktrefoil ( <i>Desmodium rotundifolium</i> ). Occurs on middle and upper slopes with acidic, low-nutrient, well-drained soils.	Successional forest—May transition to beech forest without disturbance. May stay oak-hickory with climate change with northward range shift and increasing fire frequency.
Dry-mesic Appalachian oak-hickory forest	Occurs on well-drained fine sandy loam soil. Beech, paper birch, and dry-site herbs more abundant. See “Mesic Appalachian oak-hickory forest” below.	Successional forest—Need fire or logging to maintain. Transition to sugar maple/beech forests without disturbance. May stay oak-hickory with climate change with northward range shift and increasing fire frequency.

Plant Community	Population/Habitat Attributes (Soils, Structure, Species Composition)	Natural Processes/Limiting Factor
Mesic Appalachian oak-hickory forest	Mesic and dry-mesic sites dominated by oaks ( <i>Q. rubra</i> , <i>Q. velutina</i> ), hickories ( <i>C. ovata</i> ), white pine, and transitional hardwoods ( <i>Betula lenta</i> , <i>Prunus serotina</i> , <i>Fraxinus americana</i> , <i>Betula papyrifera</i> , <i>Fagus grandifolia</i> , and <i>Tsuga canadensis</i> ). Shrub ( <i>Viburnum acerifolium</i> , <i>Corylus cornuta</i> , <i>Hamamelis virginiana</i> , <i>Toxicodendron radicans</i> , <i>Mitchella repens</i> , <i>Gaultheria procumbens</i> , <i>Lycopodium</i> ) and herb ( <i>Aralia nudicaulis</i> , <i>Maianthemum canadense</i> ) layer sparse to moderate. Silt loam soils with high moisture capacity or at slope-bases	Successional forest—Need fire or logging to maintain. Transition to sugar maple/beech forests without disturbance. May stay oak-hickory with climate change.
Dry to wet field mosaic	The wet meadows tend to occur on poorly drained silt or sand soils with a mixture of wetland and upland grasses, forbs, and occasional shrubs. For example, little bluestem ( <i>S. scoparium</i> ), sedges ( <i>Carex spp.</i> ), goldenrods ( <i>Solidago spp.</i> ), ferns ( <i>O. sensibilis</i> , <i>A. filix-femina</i> ), raspberries ( <i>Rubus spp.</i> ), arrowleaf ( <i>Polygonum sagittatum</i> ) and alder ( <i>Alnus spp.</i> ). The drier portions of these mosaics tend to occur on well-drained fine sandy loams and loam soils. The vegetative composition is dominated mainly by forbs and common pasture grasses (e.g., <i>Agrostis spp.</i> , <i>Festuca spp.</i> , <i>Poa spp.</i> ). Some of the forbs and woody shrubs include milkweeds ( <i>Asclepias spp.</i> ), meadowsweet, stepple bush ( <i>Spirea spp.</i> ), goldenrods ( <i>Solidago spp.</i> ), and <i>Rubus</i> species.	The wet meadows are likely to succeed into red maple swamps/wet forest (e.g., red maple–sensitive fern forest or red maple–elm–lady fern forest). Dry-mesic fields will most likely succeed to oak–hickory forest without active management (e.g., fire and mowing). Also, both communities need monitoring for exotics as these sites are very susceptible to invasion due to disturbance from management actions. For example, reed canarygrass is the dominant species in the wet portion of the field and leafy spurge and autumn olive is common in dry areas.
Dry shrubland mosaic	Often contain many of the same grasses and forbs of dry field communities but have a higher abundance of young trees and shrubs. Species will vary with local seed sources but tree saplings often include birch ( <i>Betula spp.</i> ), aspen ( <i>Populus spp.</i> ), pine ( <i>Pinus spp.</i> ), and cherry ( <i>Prunus spp.</i> ). Shrub species include sweet fern ( <i>Comptonia peregrina</i> ), bayberry ( <i>Morella pensylvanica</i> ), blueberry ( <i>Vaccinium spp.</i> ), and raspberries ( <i>Rubus spp.</i> ).	On well-drained sandy loams and loam soils with a water table well below the ground surface. Often succeeding from dry fields, these communities tend to be susceptible to invasive species like autumn olive and honeysuckle. May succeed to oak-hickory forest without management (e.g., mowing, burning).
Mesic Shrubland mosaic	Shrubs species of these communities are dogwoods ( <i>Cornus spp.</i> ), blueberries ( <i>Vaccinium spp.</i> ), raspberries ( <i>Rubus spp.</i> ), birches ( <i>Betula spp.</i> ), fruit species ( <i>Malus spp.</i> , <i>Pyrus spp.</i> ), alders ( <i>Alnus spp.</i> ) eastern red cedar ( <i>Juniperus virginiana</i> ), and buckthorns ( <i>Ramnus spp.</i> ). The groundcover is composed of grasses (e.g., <i>Agrostis spp.</i> , <i>Festuca spp.</i> , <i>Poa spp.</i> ) and forbs such as goldenrods ( <i>Solidago spp.</i> ), asters ( <i>Aster spp.</i> ), and vetches ( <i>Vicia spp.</i> ). The mesic soil conditions of these shrublands are well-drained silt loam and fine sandy loam soils. However, the silt of these soils will have greater moisture retention compared to coarser soils.	These soil conditions tend to have seasonally high water tables compared to the dry-mesic fields and are very susceptible to invasion by exotics such as, buckthorn, and honeysuckle. A high abundance of invasive species may impede regeneration of native trees, but this community will likely succeed to mesic Appalachian oak-hickory forest if left unmanaged.

Plant Community	Population/Habitat Attributes (Soils, Structure, Species Composition)	Natural Processes/Limiting Factor
Low red maple-elm/musclewood/lady fern silt forest	Red maple ( <i>Acer rubrum</i> ) is the dominant tree with American elm ( <i>Ulmus americana</i> ), white pine ( <i>Pinus strobus</i> ), white ash ( <i>Fraxinus americana</i> ), and swamp white oak ( <i>Quercus bicolor</i> ) present. The understory is commonly composed of musclewood ( <i>Carpinus caroliniana</i> ), climbing poison-ivy ( <i>Toxicodendron radicans</i> ), winterberry holly ( <i>Ilex verticillata</i> ), and northern arrowwood ( <i>Viburnum dentatum</i> ), with a well-developed herb layer dominated by lady fern ( <i>Athyrium filix-femina</i> ). Other species include sensitive fern ( <i>Onoclea sensibilis</i> ), violets ( <i>Viola spp.</i> ), spotted touch-me-not ( <i>Impatiens capensis</i> ), and high bush blueberry ( <i>Vaccinium corymbosum</i> ).	Occurs at intermediate zones between uplands and wetlands. Established on poorly drained silt loams with seasonally high water table. However, are not regularly flooded. Great Bay site threatened by invasive species including; buckthorn, honeysuckle, multiflora rose, and barberries.
Black gum-red maple basin swamp	Dominated by black gum ( <i>Nyssa sylvatica</i> ) and red maple ( <i>Acer rubrum</i> ) as tree canopy, highbush blueberry ( <i>Vaccinium corymbosum</i> ) and winterberry ( <i>Ilex verticillata</i> ) as the primary shrub layer, and cinnamon fern ( <i>Osmunda cinnamomea</i> ) and sphagnum moss as the herbaceous layer. Well-developed hummocks.	Typically found in perched upland till basins, acidic, nutrient-poor, poorly drained peat or mucky soils. Dependent on precipitation (rarity ranking: S1S2-imperiled or critically imperiled in New Hampshire).
Seasonally saturated red maple swamp	Common red maple swamp associated with stream drainages. Soils are typically alluvial or shallow muck/peat over alluvial minerals. Red maple ( <i>Acer rubrum</i> ) is the primary tree species, with shrub layer absent or moderately dense. Clonal graminoids such as upright sedge ( <i>Carex stricta</i> ) and blue joint ( <i>Calamagrostis canadensis</i> ) are frequent dominants.	S4S5—Differ from floodplain forests by seasonal rather than temporarily flooded water regime. Low-energy environment allows for development of organic soils. Commonly successional from wet meadows to shallow emergent marshes and have either woodland or forest canopy structure (Rarity ranking: S4S5-widespread and apparently secure in New Hampshire, may be rare in parts of its range, especially at the periphery).
Red maple/sensitive fern-tussock sedge basin/seepage	Saturated or seasonally saturated soils with diverse assemblage of herbaceous species and relatively little sphagnum moss (less than five percent). Typically occupying headwater basins, where seepage or non-channelized upland runoff is water source. Dominated by red maple, with lesser quantities of elm ( <i>Ulmus americana</i> ) and other hardwood. Sensitive fern ( <i>Onoclea sensibilis</i> ) is a good indicator. Diverse shrub layer dominated by winterberry ( <i>Ilex verticillata</i> ), with assemblages of northern highbush blueberry ( <i>V. corymbosum</i> ), southern arrowwood ( <i>V. dentatum</i> ), speckled alder ( <i>Alnus incana</i> ), and meadowsweet ( <i>Spiraea alba</i> ). Other dominant herbaceous layers include sedges ( <i>Carex stricta</i> and <i>C. bromoides</i> ), Jewelweed ( <i>Impatiens capensis</i> ), blueflag ( <i>Iris versicolor</i> ), earth loosestrife ( <i>Lysimachia terrestris</i> ), fringed sedge ( <i>Carex crinita</i> ), royal fern ( <i>Osmunda regalis</i> ), and bluejoint ( <i>Calamagrostis canadensis</i> ) may be present.	Often found with other swamp communities in larger mosaic. The largest complex at Great Bay is 65 acres in size. Circumnetral seepage swamp—Found at Pease Tradeport. (rarity ranking: S1?- critically imperiled in New Hampshire).



Plant Community	Population/Habitat Attributes (Soils, Structure, Species Composition)	Natural Processes/Limiting Factor
Speckled alder basin/seepage shrub thicket	Dominated by speckled alder ( <i>Alnus incana</i> ) with lower abundance of red osier dogwood ( <i>Cornus sericea</i> ), mountain holly ( <i>Nemopanthus mucronatus</i> ), mountain fly honeysuckle ( <i>Lonicera villosa</i> ), meadowsweet ( <i>Spiraea alba</i> ), steplebush ( <i>S. tomentosa</i> ), possumhaw ( <i>Viburnum nudum</i> ), and currant ( <i>Ribes spp.</i> ). Herbaceous cover include sedges ( <i>C. triperma</i> , <i>C. canescens</i> , <i>C. echinata</i> ) and ferns ( <i>Dryopteris cristata</i> , <i>D. carthusiana</i> , <i>Gymnocarpium dryopteris</i> ).	Occurs in open headwater basin, in somewhat seepy subacidic fens and along small low-energy streams.
Graminoid-forb-sensitive fern seepage marsh	Sensitive fern ( <i>O. sensibilis</i> ) tends to be most dominant within these systems along with other indicative species composed of sedges ( <i>C. lacustris</i> , <i>C. scabrata</i> ), ferns ( <i>O. regalis</i> , <i>T. palustris</i> ), skunk cabbage ( <i>Symplocarpus foetidus</i> ), and saxifrage spp. ( <i>S. pennsylvanica</i> , <i>C. americanum</i> ). Species in lower abundance include spotted touch-me-not ( <i>I. capensis</i> ), field mint ( <i>Mentha arvensis</i> ), and poison sumac ( <i>Toxicodendron vernix</i> ). Soils are shallow fibric peats or silty muck/sands with pH ranging from 5.5 to 6.3.	Associated with groundwater discharge zones with little canopy cover (e.g., upland borders of various wetlands and along stream drainages). Under certain conditions may succeed into speckled alder wooded fen.
Tall graminoid emergent marsh	Shallow emergent marsh dominated by “tall” graminoids, typically blue-joint ( <i>Calamagrostis canadensis</i> ), rattlesnake manna-grass ( <i>Glyceria canadensis</i> ), whitegrass ( <i>Leersia virginica</i> ) or oryzoides, reed canarygrass ( <i>Phalaris arundinaceae</i> ), threeway sedge ( <i>Dulichium arundinaceum</i> ), upright sedge ( <i>Carex stricta</i> ), <i>C. lacustris</i> , woolgrass ( <i>Scirpus cyperinus</i> ), and Canadian rush ( <i>Juncus canadensis</i> ). A broad diversity of herbaceous plants is often present, but not dominant. Community with high species diversity.	Seasonally flooded communities on fine mineral to organic substrates along low-energy streams or open basins. Dominant species form rhizomatous and colonial mats, and is influenced by hydrologic regime and propagule availability. May succeed to scrub-shrub or forested swamps or deepwater marshes depending on hydrology.
Open-basin cattail marsh	Contain mucky organic soils that are seasonally to semi-permanently flooded. Soils remain saturated throughout the year with water levels near or above the ground surface. Well-developed clonal stands often have a thick mat of thatch from previous year’s growth. Although dominated by common cattail ( <i>Typha latifolia</i> ), other species present include knotweed ( <i>Polygonum spp.</i> ), <i>Bidens spp.</i> , and <i>Scirpus</i> species.	Found in open basins associated the backwaters of ponds, lakes, or stream drainageways. May be susceptible to common reed ( <i>Phragmites australis</i> ) invasion.
Short graminoid-forb emergent marsh/mudflat	Mudflats composed of short herbaceous vegetation that is seasonally flooded or intermittently exposed. Dominated by cut-grasses ( <i>Leersia spp.</i> ) and manna-grass ( <i>Glyceria spp.</i> )	Narrow border on edge of Peverly Pond, probably dependent upon seasonal dry spells.
Red pine forest/woodland	Occurring on sand plains and other well drained soils or pockets of cold-air drainages. Red pine ( <i>Pinus resinosa</i> ) is the main canopy species with a few white pines ( <i>Pinus strobus</i> ), oaks ( <i>Q. rubra</i> , <i>Q. alba</i> ), and shagbark hickories ( <i>Carya ovata</i> ). The understory contains blueberries ( <i>Vaccinium spp.</i> ).	Occurs on sand plains and other well-drained soils or cold-air drainage. Fire interval of 175 to 200 years. Refuge population is about 150 years old, but younger stand of red pine regenerating (about 10 to 20 years old).

Plant Community	Population/Habitat Attributes (Soils, Structure, Species Composition)	Natural Processes/Limiting Factor
Pine plantations	Four separate plantations, each with different species of trees. 1. White fir ( <i>Abies concolor</i> ) approximately 25 years old. 2. Blue Spruce ( <i>Picea pungens</i> ). 3. White pine ( <i>Pinus strobus</i> ) approximately 25 years old. 4. White spruce ( <i>Picea glauca</i> ), trees approximately 30-feet tall.	Naturally reverting to oak-hickory forest; planted pines dying from disease. Monitor for invasives (e.g., common buckthorn and autumn olive).
Low salt marsh	Dominated by smooth cord-grass ( <i>Spartina alterniflora</i> ) with soils of organic materials atop sandy or silty materials. Pannes and pools can be found within the low salt marsh and some vascular halophytes that may occur in low-abundance include common glasswort ( <i>Salicornia europaea</i> ), orach ( <i>A. hastate</i> , <i>A. glabriuscula</i> ), sea blites ( <i>Suaeda spp.</i> ), and macroalgae (e.g., <i>Ascophyllum nodosum</i> and <i>Fucus spp.</i> ).	Occurring along coastal shorelines that are protected from high-energy wave action. The Low marsh is found between the mean sea level and mean high tide resulting in daily flooding with soil water salinity levels between 18 to 30 parts per thousand (ppt).
High salt marsh	Soils are generally organic materials (greater than 50 inches) on top of sand, silt, or bedrock. Salt-meadow cord-grass ( <i>Spartina patens</i> ) is the dominant vegetation but other common plants include short form smooth cord-grass ( <i>S. alterniflora</i> ), spike-grass ( <i>Distichlis spicata</i> ), and salt marsh rush ( <i>Juncus gerardii</i> ). The greatest species richness is found along the upper landward edge of the marsh and includes seaside goldenrod ( <i>Solidago sempervirens</i> ) and a variety of grasses (e.g., <i>Panicum virgatum</i> , <i>Hierochloa odorata</i> , <i>Festuca rubra</i> , <i>Elytrigia repens</i> , <i>Elymus virginicus</i> ). Pannes and pools occur within the high salt marsh.	Found adjacent to the low salt marsh and occurring landward of the mean high tide mark stretching to the upper reaches of spring tides. These systems are irregularly flooded (less than daily) and have soil water salinity levels between 18 to 30 ppt.
Brackish marsh	Soils are likely sulfhemist with low surface salt content. These support a variety of species that are tolerant of the brackish conditions. The most abundant species is narrow-leaved cattail ( <i>Typha angustifolia</i> ), but other species found in this system include rushes ( <i>Scirpus robustus</i> , <i>S. pungens</i> ), seaside goldenrod ( <i>Solidago sempervirens</i> ), fresh-water cordgrass ( <i>Spartina pectinata</i> ), broadleaf cattail ( <i>Typha latifolia</i> ), and halberd-leaved orach ( <i>Atriplex hastata</i> ).	Along upper edges of high salt marshes where fresh water runoff or groundwater discharge flows onto the marsh surface. Only flooded by salt water during spring tides and storm surges resulting in soil water salinity ranging from greater than 0.5 to less than 18 ppt.
Low/high salt marsh complex	Combination of low and high salt marsh communities (see above). However, rather than moving on a gradient from shore to upland, the high marsh is sporadically intermixed with the low marsh due to small-scale changes in surface elevation.	Elevation changes may be due to ice scouring, erosion, and/or soil/sod deposition from ice rafts.

Plant Community	Population/Habitat Attributes (Soils, Structure, Species Composition)	Natural Processes/Limiting Factor
Coastal Rocky Headland	Occurring on bedrock with thin, acidic soil along exposed rocky points in close proximity to salt spray. Dominated by stunted eastern red cedar ( <i>Juniperus virginiana</i> ) with lesser amounts of black oak ( <i>Quercus velutina</i> ) and pines ( <i>Pinus strobes</i> , <i>P. resinosa</i> ). The understory is composed of blueberries ( <i>Vaccinium spp.</i> ), northern bayberry ( <i>Myrica pensylvanica</i> ), and creeping juniper ( <i>Juniperus communis</i> ).	Exposed to salt spray and maritime climate. Potential risk to invasion by established European barberry.
Coastal Shoreline Strand/Swale	Sparsely vegetated (often less than 25 percent) upper intertidal region of fine to coarse soils. Covered with wrack composed of driftwood, <i>S. alterniflora</i> detritus, and macroalgae. Sea-rocket ( <i>Cakile edentula</i> ) is the dominant vegetation. Other species present include poison-ivy ( <i>Toxicodendron radicans</i> ) and seaside goldenrod ( <i>Solidago sempervirens</i> ).	Located in protected estuarine shorelines or backdune depressions that are flooded less than daily.
Intertidal Rocky Shore	Estuarine rivers, streams, or partially enclosed shoreline composed of coarse soils, rubble, and bedrock substrates. Vegetation is mainly macroalgae ( <i>A. nodosum</i> , <i>F. vesiculosus</i> ).	Flooded daily by tides but protected from strong currents and high-energy wave action.
Forest On Fill	Approximately 20-year old forest on sandy, silty fill of odorhents soil. Tree species include: trembling aspen ( <i>Populus tremuloides</i> ), birches ( <i>Betula populifolia</i> , <i>B. papyrifera</i> ), red maple ( <i>Acer rubrum</i> ), white pine ( <i>Pinus strobus</i> ), and white ash ( <i>Fraxinus americana</i> ). Understory species include blackberry ( <i>Rubus spp.</i> ) and dogwood ( <i>Cornus spp.</i> ).	Invasives (buckthorns and multi-flora rose) established in understory.

## 2) Identify Priority Resources of Concern

To guide the determination of which resources of concern should be a management priority, the planning team consulted the previously mentioned bird conservation plans, partner prioritization lists, the refuge's purposes, and the Service's Biological Integrity, Diversity, and Environmental Health Policy. We also used survey data for the refuge and surrounding area, and analyzed current and potential natural vegetation and desired future conditions.

As previously mentioned, the refuge needs to consider multiple geographic scales when determining its greatest contribution to species and habitat conservation. This type of analysis ensures the refuge's goals are compatible, significant, and relevant to the resource at various scales. It is also necessary to understand the scale in which other conservation partners are operating within the larger regional planning area, local planning area, State, or bird conservation region. Refuges are often unique within cooperative regional conservation planning efforts because they are part of the larger Refuge System; they are one of the few conservation entities that need to consider their role at the continental scale. While it may seem counterintuitive, incorporating large-scale perspectives can assist in narrowing the focus in deciding management priorities within certain management units (Knopf 1994). In fact, a refuge's highest priority may be decided based on its contribution to priority resources at the continental scale.

### 2.1) Regional Plan Ranking

Various Service programs and partner agencies and organizations have developed regional "prioritization rankings" for various resources of concern. These represent the best science and professional judgment of the larger conservation community. We used this as a "first filter" to identify priority resources of concern. Table B.2 below identifies the lists and rankings that were used.

**Table B.2. Regional Plans and Lists and their Respective Rankings.**

Regional Plans and Lists	Rankings selected for Priority Species
Federal List of Threatened and Endangered Species	Threatened, endangered, and candidate species supported by refuge habitats
U.S. Fish and Wildlife Service - Birds of Conservation Concern (BCC)	All species supported by refuge habitats on the BCC list for BCR 30
U.S. Fish and Wildlife Service - Birds of Management Concern	All species supported by refuge habitats
BCR 30 Priority Species List	Species supported by refuge habitats with priorities of “highest high” or “high”
PIF 9 Priority Species List	Species supported by refuge habitat with priorities of 1A, 2A, 2B, or 2C
U.S. Shorebird Conservation Plan–Atlantic Flyway	All species supported by refuge habitats that also have BCR 30 priorities of either “highest high” or “high”
North American Waterbird Conservation Plan	All species supported by refuge habitats that also have BCR 30 priorities of either “highest high” or “high”
North American Waterfowl Management Plan	All species supported by refuge habitats that also have BCR 30 priorities of either “highest high” or “high”
U.S. Fish and Wildlife Service–List of Fish Trust Species	Declining species in Gulf of Maine ecoregion supported by refuge habitats
Priority Marine Mammals	All species supported by refuge habitats (none identified)
NHB Rare Species Distribution and Occurrence Maps	All threatened and endangered plants and invertebrates, and regionally rare birds supported by refuge habitats
New Hampshire Comprehensive Wildlife Conservation Plan Priorities	All non-bird species with Species Action Plan supported by refuge habitats
NHB Natural Communities of New Hampshire	Exemplary or underrepresented communities in the State (G1-3; S1-2)

Supporting Discussion:

Partners In Flight (PIF) and Bird Conservation Regions (BCRs) have incorporated both the regional and continental scales into their species ranks, providing a starting point for selecting priority bird species for a refuge. PIF (landbirds) and BCR (all birds) plans use Breeding Bird Survey and Breeding Bird Atlas data to identify species that are of high conservation priority for defined geographic regions. The priorities are based on long-term declines and threats to long-term viability, as well as the ability of conservation actions in a particular geographic region to contribute to long-term population stability based on relative abundance of the species population.

The PIF/BCR tiering helps prioritize landbird conservation efforts at different scales. The role of refuges is to address the habitats of species of high continental concern and species that have a high proportion of their population in a particular BCR. This will allow an individual refuge to have the greatest impact nationally and regionally, while contributing to BCR goals. By first looking at the habitats of selected species, we maximize the efforts of the Refuge System by managing for the habitats with the highest ranking species, which typically represent the habitats unique to that portion of the continent.

For non-bird species, where regional and national scale prioritizations are not available, we relied on New Hampshire Natural Heritage and Piscataqua Regional Estuaries Partnership priorities and reports.

## 2.2) Review of Baseline Wildlife Surveys

We did a comprehensive review of baseline wildlife surveys conducted to date to assist with determining species presence and abundance on the refuge. Additional surveys were conducted during the CCP process as budget and staffing allowed. We selected species prioritized in regional plans and were consistently found on the refuge in good abundance for the Priority List. Rare species that occur in small numbers, had historical distribution on the refuge, or had potential for reintroduction and recolonization also were selected for the Priority List. The list of surveys and their results are described in detail in chapter 3.

## 2.3) Reviewed Habitat Requirements and Current Distribution

For species that were not already documented on the refuge through survey data, we reviewed species habitat requirements and current species distribution to determine the likelihood of the species to be on the refuge and the potential for the refuge to contribute significantly to the State, regional, or national population. Our main sources included Birds of North America Online (Cornell University) and species profiles from the New Hampshire State Wildlife Action Plan.

## 2.4) Gather Expert Opinion

### *Partner Meeting*

We met with various State and Federal agencies to discuss Great Bay Refuge's greatest contribution to the Great Bay Estuary region, the State, and the Northeast.

### *Site Visit with Community Ecologist*

In 1999, NHB conducted sites visits to develop habitat community maps for the Great Bay Refuge. Dan Sperduto, author of the "Natural Communities of New Hampshire" did the initial mapping. Afterwards, he revisited the refuge to work with the refuge biologist to identify exemplary communities and site capacities of altered habitats.

### *Consultation with Other Experts*

For certain species with little to no survey data, such as bats, amphibians, and reptile use on refuge, we consulted with local and regional experts, including Dave Yates from Biodiversity Research Institute and Kim Babbitt from University of New Hampshire.

## 3) Select Focal Species by Refuge Habitat Types

### 3.1) Associating Priority Resources of Concern to Refuge Habitat Types

While vegetative communities are mainly dictated by soils, hydrology, and plant communities, many wildlife species use more than one vegetative community. In fact, the juxtaposition of different vegetative communities in the landscape provides the various habitat requirements for specific species. For example, many amphibians and reptiles breed in seasonal wetlands, called vernal pools, but spend the majority of their life cycle in adjacent upland habitat. Table 3.9 in chapter 3 of the CCP sorts the mapped vegetative communities into broad habitat categories that are more meaningful from a wildlife management standpoint. All goals, objectives, and strategies in the CCP are developed for these broader habitat categories. We then assigned the priority resources of concern to these habitat categories. As most refuge management activities are focused on habitat manipulation or restoration, this association ties the species priorities into tangible management objectives.

### 3.2) Incorporating Biological Integrity, Diversity, and Environmental Health Elements

In selecting priority resources of concern and focal species, we used the biological integrity, diversity, and environmental health elements table (table B.1) to identify the refuge's capability and greatest contribution. Filters used include site capabilities, limiting factors, response to management or restoration, as well as, ability to maintain or restore aspects of ecological or ecosystem processes within the refuge and surrounding landscape. A few examples of these filters are highlighted below.



*Site Capability/Limiting Factors.* Under current refuge management, the refuge would manage for many small grassland units. Baseline surveys indicate that most of these small grasslands do not provide benefits to priority grassland nesting birds. Additionally, soil maps and additional soil surveys confirm that the soils mainly support forested habitat (oak-hickory forest or maple/beech forests). The annual mowing of these numerous small tracts also increases management burden. During the CCP process, we reevaluated grassland management and proposed to focus on maintaining and restoring two to three large grassland units, with dry and sandy soils that would be more appropriate to maintain as a grassland. These areas also had historic records of upland sandpipers, a priority species for the State.

*Response to Management or Restoration.* Although currently not present at Great Bay Refuge, we are proposing to restore and manage habitat for New England cottontail. This species is a candidate species for the Federal List of Threatened and Endangered Species. It is currently persisting in small (less than 10 to 20 acres), fragmented, shrub habitats in a fraction of its historical range. There is a significant extant population just across Great Bay that the refuge is working with partners to protect. One of the major threats to this species is that lack of habitat management on conserved lands to provide the early successional (dense shrub) habitat it requires. Refuges have the expertise, equipment, and a mandate to manage for this species, thus providing a unique opportunity to expand the existing population and restore new populations. Unlike other habitats (like grassland or forest) which require larger contiguous tracts, managing for 10 to 20 acre shrub habitat would significantly contribute to the recovery of this species.

*Restoring Ecological Integrity and Ecosystem Process.* As described in chapter 3, New England has the longest land use history in the United States. As such, it's difficult to find areas where natural ecological processes are fully intact. However, one can often find areas where these processes are mostly intact, such as the oak-hickory community (including forested and shrub wetlands) on Great Bay Refuge. This plan proposes small changes to restore ecological integrity, such as minimizing edge habitat from trails and forest openings, and restoring hydrological flow in the lower Peverly Brook.

### 3.3) Selecting Focal Resources

For each of these broad habitat categories types, we then selected focal resources for management and monitoring purposes. Focal resources are highly associated with conditions that represent the needs of larger groups of species or communities that have similar requirements (e.g., habitats, ecological and/or ecosystem processes) and respond to management similarly. When wildlife are selected as focal resources, they may be selected because they reflect the distribution and abundance of species with similar requirements (focal species), their protection covers a wide range of co-existing species in the same habitat (umbrella species), a species whose status provides information on the overall condition of the ecosystem and of other species in that ecosystem (indicator species), or species that have an effect on many other species in an ecosystem disproportionate to their abundance or biomass (keystone species). By managing for focal resources, important components of functional, healthy ecosystems will be addressed. Also, through our management for focal resources, we hope to conserve our priority species and habitats. The following table identifies refuge habitat types and associated focal species.

**Table B.3. Priority Habitat Types and Their Associated Focal Species for Great Bay Refuge.**

Priority Habitat Types	Associated Focal Species
Freshwater impoundments	Marsh wren, migrating and wintering waterfowl, nesting marshbirds, alewife, blueback herring, American eel, large bur-reed
Intertidal Estuarine*	Eelgrass beds, oysters, alewife, blueback herring , American eel
Salt marsh and rocky shoreline	Wintering black duck, wintering bald eagle, foraging marsh and wading birds, migratory shorebirds, salt marsh sparrow, seaside mallow, American eel
Forested and scrub-shrub wetlands and vernal pools	Willow flycatcher, wood thrush, vernal pool obligate amphibians, foraging woodcock, and native plant communities

Priority Habitat Types	Associated Focal Species
Oak-hickory forest	Wood thrush, scarlet tanager, Baltimore oriole, solitary tree bats
Shrubland	Eastern towhee, prairie warbler, blue-winged warbler, American woodcock, black racer, New England cottontail
Grassland	Upland sandpiper, American woodcock, Eastern meadowlark, New England blazing star

\* *This habitat type does not occur on the refuge, but is an important priority habitat in the Great Bay Estuary.*

## Literature Citations

- Dettmers, Randy. 2006. Draft: Blueprint for the Design and Delivery of Bird Conservation in the Atlantic Northern Forest. U.S. Fish and Wildlife Service, Hadley, MA. 352 p.
- Dunn, Erica H.; D.J.T. Hussell, and D.A. Welsh. 1998. Priority-Setting Tool Applied to Canada's Landbirds Based on Concern and Responsibility for Species. *Conservation Biology*. Vol. 13 No. 6 pgs 1404-1415.
- Ford, Robert P., and M.C. Roedel. 2004. Bird conservation planning in the interior low plateaus. In: Bonney, Rick; D. N. Pashley; R.J. Cooper; L. Niles, eds. 2000. *Strategies for bird conservation: The Partners In Flight planning process; Proceedings of the 3rd Partners in Flight Workshop; 1995 October 1-5; Cape May, NJ. Proceedings RMRS-P16. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.*
- Freemark, Kathryn E.; J.R. Probst; J.B. Dunning and S.J. Hejl. 1993. Adding a Landscape Ecology Perspective to Conservation and Management Planning. In, Finch, Deborah M. and P.W. Stangel, eds. *Status and Management of Neotropical Migratory Birds; 1992 September 21-25; Estes Park, Co. Gen. Tech. Rep. RM-229. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.* 422 p.
- Knopf, Fritz L. and F.B. Samson. 1994. Scale Perspectives on Avian Diversity in Western Riparian Ecosystems. *Conservation Biology*, Vol. 8, No. 3. pages 669-676.
- McWilliams, William H.; B. Butler; L. Caldwell; D. Griffith; M. Hoppus; K. Laustsen; A. Lister; T. Lister; J. Metzler; R. Morin; S. Sader; L. Stewart; J. Steinman; J. Westfall; D. Williams; A. Whitman; and C. Woodall. 2004. *The Forests of Maine: 2003. Resource Bulletin NE-164 September 2005. U.S. Department of Agriculture, Forest Service. Northeastern Research Station, Newtown Square, PA.* 195p.
- Mueller, Allen J.; D.J. Twedt and C.R. Loesch. 2000. Development of Management Objectives for Breeding Birds in the Mississippi Alluvial Valley. In: Bonney, Rick; D. N. Pashley; R.J. Cooper; L. Niles, eds. 2000. *Strategies for bird conservation: The Partners In Flight planning process; Proceedings of the 3rd Partners in Flight Workshop; 1995 October 1-5; Cape May, NJ. Proceedings RMRS-P16. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.*
- Nazaire, Mare. 2005. A Study of the Vegetation and Floristic Diversity of Two Peatland Complexes of Post-Settlement Origin in Lake Umbagog National Wildlife Refuge, Coos County, New Hampshire. Master of Science Thesis, University of New Hampshire. 192 p.
- Panjabi, Arvind. 2001. *The Partners In Flight Handbook on Species Assessment & Prioritization. Version 1.1 December 2001. Rocky Mountain Bird Observatory.*
- Probst, John R. and F.R. Thompson, III. 1996. A multiscale assessment of the geographic and ecological distributions of Midwestern Neotropical migratory birds. Pages 22-40 in Thompson, F.R., III (ed.), *Managing Midwestern landscapes for the conservation of neotropical migratory birds. Gen. Tech. Rep. NC-187. USDA Forest Service.*
- Ralph, C. John and T.D. Rich, eds. *Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference. 2002 March 20-24; Asilomar, CA, Volume 1. Gen. Tech. Rep. PSW-GTR-191. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.* 651 p.

- Rich, T.D.; C.J. Beardmore; H. Berlanga; P.J. Blancher; M.S. Bradstreet; G. S. Butcher; D.W. Demarest; E.H. Dunn; W.C. Hunter; E.E. Inigo-Elias; J.A. Kennedy; A.M. Martell; A.O. Panjabi; D.N. Pashley; K.V. Rosenberg; C.M. Rustay; J.S. Wendt; and T.C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, NY.
- Rosenberg, Kenneth V. and T.P. Hodgman. 2000. Partners In Flight Landbird Conservation Plan: Physiographic Area 28: Eastern Spruce-Hardwood Forest. Draft 1.0. American Bird Conservancy. p48.
- Rosenberg, Kenneth V. and J.V. Wells. 2000. Global perspectives on neotropical migratory bird conservation in the Northeast: Long-term responsibility versus immediate concern. In: Bonney, Rick; D. N. Pashley; R.J. Cooper; L. Niles, eds. 2000. Strategies for bird conservation: The Partners In Flight planning process; Proceedings of the 3rd Partners in Flight Workshop; 1995 October 1-5; Cape May, NJ. Proceedings RMRS-P16. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Rosenberg, Kenneth V. and J.V. Wells. 1995. Importance of geographic areas to Neotropical migrant birds in the Northeast. Final report to U.S. Fish and Wildlife Service, Region-5, Hadley, MA.
- Sauer, John R. 2004. Combining information from monitoring programs: complications associated with indices and geographic scale. In: Bonney, Rick; D. N. Pashley; R.J. Cooper; L. Niles, eds. 2000. Strategies for bird conservation: The Partners In Flight planning process; Proceedings of the 3rd Partners in Flight Workshop; 1995 October 1-5; Cape May, NJ. Proceedings RMRS-P16. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Sauer, John R.; J.K. Casey; H. Laskowski; J.D. Taylor and J. Fallon. 2005. Use of Survey Data to Define Regional and Local Priorities for Management on National Wildlife Refuges. In: Ralph, John C. and T.D. Rich, eds. Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference. 2002 March 20-24; Asilomar, CA, Volume 2. Gen. Tech. Rep. PSW-GTR-191. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; Pgs 1224-1231.
- Schroeder, Richard L.; J. Holler and J. P. Taylor. 2004. Managing National Wildlife Refuges for Historic or Non-Historic Conditions: Determining the Role of the Refuge in the Ecosystem. In: Managing Biological Integrity, Diversity, and Environmental Health in the National Wildlife Refuges. Natural Resources Journal. Fall 2004. Vol. 44, No. 4. Pgs.1041-1066.
- Scott, J. Michael; T. Loveland; K. Gergely; J. Strittholt and N. Staus. National Wildlife Refuge System: Ecological Context and Integrity. In: Managing Biological Integrity, Diversity, and Environmental Health in the National Wildlife Refuges. Natural Resources Journal. Fall 2004. Vol. 44, No. 4. Pgs.1041-1066.
- Schneider, K.J., and D.M. Pence, eds. 1992. Migratory nongame birds of management concern in the Northeast. U.S. Dep. Inter., Fish and Wildlife Service, Hadley, MA. 400p.
- Sportza, Lucy M. 1999. Regional approaches to planning for protected areas and conservation. *Environments*, 29(3): 1-14.
- U.S. Fish and Wildlife Service. 1991. Final Environmental Assessment Proposal to Protect Wildlife Habitat, Lake Umbagog, Coos County, New Hampshire, Oxford County, Maine. June 1991. Hadley MA. 49 p.

## Appendix C

John J. Mosses - NBII



*Wood turtle*

## Findings of Appropriateness and Compatibility Determinations

## **Findings of Appropriateness and Compatibility Determinations**

<b>Finding of Appropriateness—Berry Picking, Mushroom Collecting, and Flower Picking . . . . .</b>	<b>C-1</b>
<b>Finding of Appropriateness—Bicycling off Public Entrance Road . . . . .</b>	<b>C-3</b>
<b>Finding of Appropriateness—Camping . . . . .</b>	<b>C-5</b>
<b>Finding of Appropriateness—Dog Walking . . . . .</b>	<b>C-7</b>
<b>Finding of Appropriateness—Geocaching (Physical Caches and/or Off-trail). . . . .</b>	<b>C-9</b>
<b>Finding of Appropriateness—Horseback Riding . . . . .</b>	<b>C-11</b>
<b>Finding of Appropriateness—Jogging. . . . .</b>	<b>C-13</b>
<b>Finding of Appropriateness—Commercial Wildlife and Nature Photography . . . . .</b>	<b>C-15</b>
<b>Compatibility Determination—Commercial Wildlife and Nature Photography . . . . .</b>	<b>C-17</b>
<b>Finding of Appropriateness—Research by Non-Service Personnel . . . . .</b>	<b>C-23</b>
<b>Compatibility Determination—Research by Non-Service Personnel . . . . .</b>	<b>C-25</b>
<b>Finding of Appropriateness—Walking, Hiking, Cross Country Skiing, and Snowshoeing . . . . .</b>	<b>C-37</b>
<b>Compatibility Determination—Walking, Hiking, Cross Country Skiing, and Snowshoeing. . . . .</b>	<b>C-39</b>
<b>Compatibility Determination—Wildlife Observation and Photography, Environmental Education, and Interpretation . . . . .</b>	<b>C-45</b>
<b>Compatibility Determination—Deer Hunting . . . . .</b>	<b>C-51</b>
<b>Compatibility Determination—Waterfowl Hunting . . . . .</b>	<b>C-55</b>



**FINDING OF APPROPRIATENESS OF A REFUGE USE****Refuge Name:** Great Bay National Wildlife Refuge**Use:** Berry Picking, Mushroom Collecting, and Flower Picking

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

<b>Decision Criteria:</b>	<b>YES</b>	<b>NO</b>
(a) Do we have jurisdiction over the use?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(d) Is the use consistent with public safety?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(g) Is the use manageable within available budget and staff?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(h) Will this be manageable in the future within existing resources?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ☒ No ☐.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ☒ **Appropriate** ☐

Refuge Manager: Greta W. Taylor Date: 7/1/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: \_\_\_\_\_ Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## **JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE**

**Refuge Name:** Great Bay National Wildlife Refuge

**Use:** Berry Picking, Mushroom Collecting, and Flower Picking

### **NARRATIVE:**

To comply with 2006 U.S. Fish and Wildlife Service (Service) policy on appropriateness, we are evaluating all non-priority public uses for Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge). Berry picking, mushroom collecting, and flower picking are not identified as a priority public uses of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. These uses will not be allowed on the refuge for several reasons.

Impacts such as trampling vegetation and wildlife disturbance would occur. Visitors walking off established public use trails may impact plants indirectly by compacting soils, increasing erosion, and walking on young plants, reducing survival and regeneration. Berries, mushrooms, and flowers can be important sources of food for various wildlife species and the removal of these can have adverse effects on wildlife species. Also, collecting of natural materials is prohibited on refuge lands by 50 C.F.R. 27.51, except by special use permit.

After evaluating these uses under Service policies, we conclude that we will not allow these activities. Berry picking, mushroom collecting, and flower picking do not support a refuge purpose, goal, or objective and would not benefit the resources within the refuge. Therefore, we find these, and similar activities, to not be appropriate for the Great Bay Refuge.

**FINDING OF APPROPRIATENESS OF A REFUGE USE****Refuge Name:** Great Bay National Wildlife Refuge**Use:** Bicycling off Public Entrance Road

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

<b>Decision criteria:</b>	<b>YES</b>	<b>NO</b>
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?		✓
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✓
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✓
(g) Is the use manageable within available budget and staff?		✓
(h) Will this be manageable in the future within existing resources?		✓
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✓

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes \_\_\_\_\_ No ✓.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ✓ **Appropriate** \_\_\_\_\_

Refuge Manager: Graham W. Taylor Date: 7/1/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: \_\_\_\_\_ Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## **JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE**

**Refuge Name:** Great Bay National Wildlife Refuge

**Use:** Bicycling off Public Entrance Road

### **NARRATIVE:**

To comply with 2006 U.S. Fish and Wildlife Service (Service) policy on appropriateness, we are evaluating all non-priority public uses for Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge). Bicycling is not a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). Bicycling will not be allowed on the trails or anywhere else on the refuge.

Bicycling may degrade the trails and cause further erosion. Although foot travel is allowed on established trails so that visitors may experience the priority public uses of wildlife observation, photography, and environmental education, biking is not required to experience these uses. Biking may degrade the trail, cause further erosion, and cause safety hazards to other visitors.

After evaluating bicycling under Service policies, current conditions, required maintenance, and demand, we conclude that we will not allow this activity. Prohibiting bicycling may positively impact soils and wildlife; if only by reducing the amount of erosion and soil compaction that might occur on trails and the frequency and extent of wildlife disturbance. Biking is not a wildlife-dependent public use, nor is it necessary to support a priority public use, and it may decrease the enjoyment of the refuge for other visitors.

However, bicycling does provide a means for many area residents and visitors to get to the refuge, and this finding does not restrict that use. The refuge does allow bicycling on the entrance road and has bike rack available at the trail parking area. There are also many other sites throughout the surrounding area that provide opportunities for bicycling.

**FINDING OF APPROPRIATENESS OF A REFUGE USE****Refuge Name:** Great Bay National Wildlife Refuge**Use:** Camping

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

<b>Decision criteria:</b>	<b>YES</b>	<b>NO</b>
(a) Do we have jurisdiction over the use?	<input checked="" type="checkbox"/>	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	<input checked="" type="checkbox"/>	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	<input checked="" type="checkbox"/>	
(d) Is the use consistent with public safety?	<input checked="" type="checkbox"/>	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		<input checked="" type="checkbox"/>
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	<input checked="" type="checkbox"/>	
(g) Is the use manageable within available budget and staff?		<input checked="" type="checkbox"/>
(h) Will this be manageable in the future within existing resources?		<input checked="" type="checkbox"/>
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	<input checked="" type="checkbox"/>	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	<input checked="" type="checkbox"/>	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes \_\_\_\_\_ No ☒.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ☒ **Appropriate** \_\_\_\_\_

Refuge Manager: Graham W. Taylor Date: 7/1/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: \_\_\_\_\_ Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**



## **JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE**

**Refuge Name:** Great Bay National Wildlife Refuge

**Use:** Camping

### **NARRATIVE:**

To comply with 2006 U.S. Fish and Wildlife Service (Service) policy on appropriateness, we are evaluating all non-priority public uses for Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge). Camping is not identified as a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. Camping will not be allowed on the refuge for several reasons.

If we allow camping on the refuge, visitors may wander offtrail to find suitable sites and consequently cause increased soil and vegetation compaction and disturbance to wildlife. Since camping would involve staying overnight on the refuge, visitors may also start fires for cooking and cut refuge vegetation for use as firewood. Unattended fires could present a fire risk. Visitors engaged in camping may also leave behind trash, food, and human waste, which could attract nuisance wildlife, result in ecological damage, and create aesthetic problems. Law enforcement and safety may also become greater concerns if campers are not responsible or do not exercise caution.

After evaluating camping under Service policies, we conclude that we will not allow this activity. Since we have never permitted camping on the refuge, we do not expect that prohibiting this activity will significantly impact current or future visitors. However, prohibiting camping may positively impact wildlife and wildlife habitat by reducing:

- The amount trash, food, and human waste left behind.
- Soil compaction and vegetation trampling.
- The frequency and extent of wildlife disturbance.

**FINDING OF APPROPRIATENESS OF A REFUGE USE****Refuge Name:** Great Bay National Wildlife Refuge**Use:** Dog Walking

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

<b>Decision criteria:</b>	<b>YES</b>	<b>NO</b>
(a) Do we have jurisdiction over the use?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(d) Is the use consistent with public safety?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(g) Is the use manageable within available budget and staff?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(h) Will this be manageable in the future within existing resources?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes \_\_\_\_\_ No ☒.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ☒ **Appropriate** \_\_\_\_\_

Refuge Manager: Graham W Taylor Date: 7/1/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: \_\_\_\_\_ Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE

**Refuge Name:** Great Bay National Wildlife Refuge

**Use:** Dog Walking

### **NARRATIVE:**

To comply with 2006 U.S. Fish and Wildlife Service (Service) policy on appropriateness, we are evaluating all non-priority public uses for Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge). Dog-walking is not identified as a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. Dog walking will not be allowed on the refuge for several reasons.

Many wildlife species perceive dogs as natural predators, which causes them to react to the presence (visual/scent) of dogs. Common reactions include vacating and avoiding areas disturbed by dogs (Lima and Bednekoff 1999, Lenth et al. 2006). Domestic dogs can also depredate native wildlife (Gill 1994).

Researchers have found that dogs displace native migratory bird species from their native habitats (Banks and Bryan 2007). Studies have also indicated that the presence of dogs on trails can decrease wildlife use within 330 feet (100 meters) of the trail (Lenth et al. 2006). Since the presence of dogs disturbs native wildlife, permitting dog walking may decrease the ability of refuge visitors to engage in wildlife observation, a priority public use of the refuge.

After evaluating dog walking under Service policies, we conclude that we will not allow this activity. We will maintain and enhance existing signage indicating dogs are not permitted to improve compliance. There are also many sites throughout the surrounding area that provide opportunities for dog owners to take their pets.

### **LITERATURE CITED:**

- Banks, P.B. and J.V. Bryant. 2007. Four-legged friend or foe? Dog walking displaces native birds from natural areas. *Animal Behavior* 3: 611-613.
- Gill, M. 1994. Bird flushing by dogs at proposed Eastshore State Park: Can they all just get along? *In* Contemporary Topics in Environmental Sciences. D. Sloan, E. Edlund, M. Christensen, K. Taylor, eds. U.C. Berkeley, Berkeley, Ca.
- Lenth, B., M. Brennan, R. L. Knight. February 2006. The Effects of Dogs on Wildlife Communities. Final research report submitted to Boulder County Open Space and Mountain Parks.
- Lima, S.L. and P.A. Bednekoff. 1999. Temporal variation in danger drives anti-predator behavior: the predation risk allocation hypothesis. *American Naturalist* 153:649-659.

**FINDING OF APPROPRIATENESS OF A REFUGE USE****Refuge Name:** Great Bay National Wildlife Refuge**Use:** Geocaching (Physical Caches and/or Off-trail)

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

<b>Decision criteria:</b>	<b>YES</b>	<b>NO</b>
(a) Do we have jurisdiction over the use?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(d) Is the use consistent with public safety?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(g) Is the use manageable within available budget and staff?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(h) Will this be manageable in the future within existing resources?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ☐ No ☒.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ☒ **Appropriate** ☐

Refuge Manager: Graham W Taylor Date: 7/1/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: \_\_\_\_\_ Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## **JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE**

**Refuge Name:** Great Bay National Wildlife Refuge

**Use:** Geocaching (Physical Caches and/or Off-trail)

### **NARRATIVE:**

To comply with 2006 U.S. Fish and Wildlife Service (Service) policy on appropriateness, we are evaluating all non-priority public uses for Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge). Geocaching is not identified as a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. This use will not be allowed on the refuge for several reasons.

This activity involves the placement of a physical cache of items in a hidden location where other people subsequently search for the hidden items. The placement of these hidden items encourages visitors to leave designated public use trails and enter into closed areas where public use is restricted. Impacts include habitat damage from the trampling of vegetation and disturbance to wildlife.

Geocaching does not support a refuge purpose, goal or objective and would not benefit the resources within the refuge. After evaluating geocaching under Service policies, we conclude that we will not allow this activity.



**FINDING OF APPROPRIATENESS OF A REFUGE USE****Refuge Name:** Great Bay National Wildlife Refuge**Use:** Horseback Riding

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

<b>Decision criteria:</b>	<b>YES</b>	<b>NO</b>
(a) Do we have jurisdiction over the use?	<input checked="" type="checkbox"/>	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	<input checked="" type="checkbox"/>	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	<input checked="" type="checkbox"/>	
(d) Is the use consistent with public safety?	<input checked="" type="checkbox"/>	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		<input checked="" type="checkbox"/>
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	<input checked="" type="checkbox"/>	
(g) Is the use manageable within available budget and staff?		<input checked="" type="checkbox"/>
(h) Will this be manageable in the future within existing resources?		<input checked="" type="checkbox"/>
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		<input checked="" type="checkbox"/>
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		<input checked="" type="checkbox"/>

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes \_\_\_\_\_ No ☒.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ☒ **Appropriate** \_\_\_\_\_

Refuge Manager: Grady W. Taylor Date: 7/1/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: \_\_\_\_\_ Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## **JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE**

**Refuge Name:** Great Bay National Wildlife Refuge

**Use:** Horseback Riding

### **NARRATIVE:**

To comply with 2006 U.S. Fish and Wildlife Service (Service) policy on appropriateness, we are evaluating all non-priority public uses for Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge). Horseback riding is not identified as a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. Horseback riding will not be allowed on the refuge for several reasons.

Horseback riding may impact soils and native vegetation through trampling and soil compaction (Kuss 1986). Horses may also leave piles of manure along the trail, degrading the enjoyment of the refuge for other visitors. Additionally, horse manure may contain viable seeds from invasive plants (Wells and Lauenroth 2007) which could become a management problem for the refuge.

Although foot travel is allowed on established trails so that visitors may experience the priority public uses of wildlife observation, photography, and environmental education, horseback riding is not required to experience these uses. Horseback riding may degrade the trail, cause further erosion on steeper areas of trails, and cause safety hazards to other visitors (Deluca et al. 1998).

After evaluating horseback riding considering Service policies, current refuge conditions, aesthetic and ecological implications, required maintenance, and demand, we conclude that we will not allow this activity. Prohibiting horseback riding may positively impact soils and wildlife; if only by reducing the amount of erosion and soil compaction that might occur on trails, the frequency and extent of wildlife disturbance, and preventing a potential vector of invasive plants. Horseback riding is not a wildlife-dependent public use, nor is it necessary to support a priority public use, and it may decrease the enjoyment of the refuge for other visitors.

### **LITERATURE CITED:**

- Deluca, T.H., W.A. Patterson, W.A. Friedmund, and D.N. Cole. 1998. Influence of llamas, horses, and hikers on soil erosion from established recreation trails in western Montana, USA. *Environmental Management* 22(2): 255-262.
- Kuss, F.R. 1996. A review of the major factors influencing plant responses to recreation impacts. *Environmental Management* 10: 638-650.
- Wells F.H., and W. K. Lauenroth. 2007. The Potential for Horses to Disperse Alien Plants Along Recreational Trails. *Rangeland Ecology & Management*: Vol. 60, No. 6 pp. 574–577.

**FINDING OF APPROPRIATENESS OF A REFUGE USE****Refuge Name:** Great Bay National Wildlife Refuge**Use:** Jogging

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

<b>Decision criteria:</b>	<b>YES</b>	<b>NO</b>
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✓
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?		✓
(h) Will this be manageable in the future within existing resources?		✓
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✓

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes \_\_\_\_\_ No ✓.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ✓ **Appropriate** \_\_\_\_\_

Refuge Manager: Grady W Taylor Date: 7/1/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: \_\_\_\_\_ Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## **JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE**

**Refuge Name:** Great Bay National Wildlife Refuge

**Use:** Jogging

### **NARRATIVE:**

To comply with 2006 U.S. Fish and Wildlife Service (Service) policy on appropriateness, we are reevaluating all non-priority public uses for Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge). Jogging is not identified as a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. Jogging, although permitted in the past, will no longer be allowed on the refuge for several reasons.

The presence of people jogging could result in some disturbance to wildlife located in habitats adjacent to the trail system. Recreational trail use has been shown to cause disturbance to wildlife up to 330 feet (100 meters) from trails (Taylor and Knight 2003). The established trails were developed so that visitors may engage in the priority public uses of wildlife observation, photography, and environmental education; jogging is not required to experience these uses. Further, the fact that it would result in incremental disturbance to wildlife additive to the priority public uses we are trying to accommodate, and may negatively affect the experience of visitors who are viewing wildlife, suggests there is no compelling reason to allow it.

After evaluating jogging under Service policies, we conclude that we will not allow this activity. Jogging is not a wildlife-dependent public use, nor is it necessary to support a priority public use, and it may decrease the enjoyment of the refuge for other visitors engaged in priority wildlife-dependent activities.

### **LITERATURE CITED:**

Taylor, A. R., and R. L. Knight. 2003. Wildlife Responses to Recreation and Associated Visitor Perceptions. *Ecological Applications*, 13 (4), 2003, pp. 951-963.

**FINDING OF APPROPRIATENESS OF A REFUGE USE****Refuge Name:** Great Bay National Wildlife Refuge**Use:** Commercial Wildlife and Nature Photography

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

<b>Decision criteria:</b>	<b>YES</b>	<b>NO</b>
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes \_\_\_\_\_ No ✓.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** \_\_\_\_\_ **Appropriate** ✓

Refuge Manager: *Frederic W. Taylor* Date: 7/1/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: *Sharon M. Munn* Date: 8/2/2012

**A compatibility determination is required before the use may be allowed.**



## **JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE**

**Refuge Name:** Great Bay National Wildlife Refuge

**Use:** Commercial Wildlife and Nature Photography

### **NARRATIVE:**

To comply with 2006 U.S. Fish and Wildlife Service (Service) policy on appropriateness, we are evaluating all non-priority public uses for Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge). Commercial photography is not identified as a priority public use of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. However, non-commercial wildlife photography is a priority public use.

Visitors engaged in commercial photography could trample vegetation along refuge trails and disturb wildlife disturbance. Recreational trail use has been shown to cause disturbance to wildlife up to 330 feet (100 meters) from trails (Taylor and Knight 2003). Wildlife disturbance would be minimized through the mandatory use of temporary and portable blinds by permittees. Because the use would only be allowed when it supports conservation, the products could potentially offset short-term impacts by enhancing public awareness of the natural resources. Some commercial photography would occur along established refuge trails and could impact plants indirectly by compacting soils, increasing erosion, and walking on young plants, reducing survival and regeneration.

After evaluating commercial photography under Service policies, we conclude that we will allow this activity. Commercial wildlife and nature photography would support refuge purposes, goals or objectives and would benefit the resources within the refuge. Therefore, this activity has been found to be appropriate for the Great Bay Refuge.

### **LITERATURE CITED:**

Taylor, A. R., and R. L. Knight. 2003. Wildlife Responses to Recreation and Associated Visitor Perceptions. *Ecological Applications*, 13 (4), 2003, pp. 951-963.

## **COMPATIBILITY DETERMINATION**

### **USE:**

Commercial Wildlife and Nature Photography

### **REFUGE NAME:**

Great Bay National Wildlife Refuge

### **ESTABLISHING AND ACQUISITION AUTHORITY(IES):**

Public Law 102-154, Section 319(d) Department of the Interior and Related Agencies Appropriations Bill, 1992.

### **REFUGE PURPOSE(S):**

Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge) was established to:

- Encourage the natural diversity of plant, fish, and wildlife species within the refuge, and to provide for their conservation and management.
- Protect species listed as endangered or threatened or identified as candidates pursuant to the Endangered Species Act of 1973.
- Preserve and enhance the water quality of aquatic habitat within the refuge.
- To fulfill the international treaty obligations of the United States relating to fish and wildlife.

### **NATIONAL WILDLIFE REFUGE SYSTEM MISSION:**

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.”—National Wildlife Refuge System Improvement Act of 1997 (Public Law 105–57; 111 Stat. 1282)

### **DESCRIPTION OF USE:**

#### **(a) What is the use? Is the use a priority public use?**

The use is commercial photography, either still or motion pictures, of wildlife or nature scenes for conservation uses. This is not a priority public use, but would be contributing to priority public uses.

#### **(b) Where would the use be conducted?**

This use will occur in areas of the refuge specified in the special use permit. The use will generally take place in areas that are open to visitors including the refuge road, parking lot, and trails. Visitors engaged in commercial photography will be required to use temporary or portable blinds to minimize disturbance to wildlife.

**(c) When would the use be conducted?**

The use may occur during daylight hours during the year.

**(d) How would the use be conducted?**

Requests must be submitted in writing to the refuge manager no less than 21 days prior to the requested date(s). Each request will be reviewed on a case-by-case basis and will require a special use permit. Other permits may be required depending on the commercial activity.

**(e) Why is this use being proposed?**

The refuge has received requests every 2 to 3 years to film or photograph habitats and/or wildlife. These requests will contribute to enhancing awareness of conservation and recreational opportunities at the refuge.

**AVAILABILITY OF RESOURCES:**

Great Bay Refuge is an unstaffed satellite administered by Parker River Refuge. Staff time from Parker River Refuge will be required to review and oversee permits and should be available to do so.

Visitor Services Specialist (GS-12) (review requests)—1 day/year = \$475

**ANTICIPATED IMPACTS OF THE USE:**

Public uses, such as commercial photography, can produce short-term, negative direct or indirect impacts on wildlife or habitats. However, we believe the long-term benefits from the conservation nature of the products could be greater. Projects will be conducted at the appropriate time of year and conditions to minimize disturbances and incorporate other best management practices.

*Direct Effects*

Direct impacts are those where the activity has an immediate effect on wildlife and/or habitats.

Trail use may lead to trampling of vegetation adjacent to the trail or compaction of soil and leaf litter. These impacts are generally localized to areas adjacent to trails or areas of frequent off-trail use. Impacts of off-trail use can include a reduction in the density of plants near trails, soil compaction, increased erosion, and damage to, or killing of, plants (Colorado State Parks 1998). To reduce the potential for these types of disturbance, markers and refuge boundary signs encourage trail users to stay on the trail to minimize effects on surrounding vegetation.

The presence of humans walking along trails can directly disturb migratory birds and other wildlife species. Wildlife often respond to human presence by departing from the disturbed site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschen et al. 1985, Henson and Grant 1991, Kahl 1991, Klein 1993), using of sub-optimal habitat or non-preferred habitat (Erwin 1980, Williams and Forbes 1980), altering their behavior (Burger 1981, Korschen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increasing their energy expenditure (Morton et al. 1989, Belanger and Bedard 1990). Human disturbances can also decrease reproductive success by causing nest abandonment, decline in parental care, altering feeding schedules, and other stresses (Colorado State Parks 1998). It can cause shifts in habitat use, lead to abandonment of habitat, and increase energy demands in affected wildlife (Knight and Cole 1991). Hammitt and Cole (1998) conclude that the frequent presence of humans in natural areas can dramatically change the behavior of some wildlife species.

Wildlife responses to human disturbance vary by species, and by the type, level, frequency, duration, and time of year of the human use. For example generalist species, which thrive in disturbed areas, are often more abundant along trails than specialist species that are more sensitive to human disturbance (Colorado State Parks 1998). Adverse impacts also tend to increase as user groups increase in size (Beale and Monaghan 2004).

Walking along trails can have impacts even outside of the immediate trail corridor (Miller et al. 2001). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. They also found that nest predation was greater near trails (Miller et. al 1998).

Overall, the direct effects of commercial wildlife and nature photography should be minor because visitors engaged in these activities will be required to use blinds and other techniques to minimize disturbance.

### *Indirect Effects*

We do not anticipate any indirect, negative impacts from this use.

### *Cumulative Effects*

Cumulative effects are effects that are minor when considered separately but may be important when considered collectively. The principal concerns are repeated disturbances of birds that are nesting, foraging, or resting.

We anticipate that this use will support refuge purposes, the National Wildlife Refuge System mission, and priority public uses, including environmental education and interpretation. It has the potential to have a very positive cumulative impact on the refuge's natural resources.

## **PUBLIC REVIEW AND COMMENT:**

As part of the comprehensive conservation planning process for Great Bay Refuge, this compatibility determination underwent extensive public review, including a comment period of 39 days that followed the release of the draft Comprehensive Conservation Plan and Environmental Assessment.

## **DETERMINATION (CHECK ONE BELOW):**

- ☐ Use is not compatible.
- ☒ Use is compatible with the following stipulations.

## **STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:**

- Sites for photo shoots will be submitted in advance and approved by the refuge manager.
- Blinds will be required for all areas that are not open to the public.
- No sound making or lighting devices will be permitted.
- Only commercial photography in support of conservation, refuge purposes, the National Wildlife Refuge System Mission, and/or for educational and interpretive purposes will be permitted.
- A special use permit will be required. Other permits may be required depending on the commercial activity.

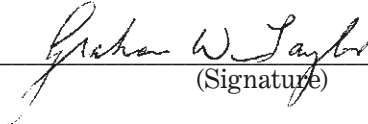
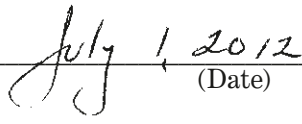
**JUSTIFICATION:**

This program as described is determined to be compatible. Any potential negative impacts of commercial wildlife and nature photography activities on refuge resources will be minimized by the restrictions included in the conditions of the special use permit. In addition, the activities associated with commercial photography will be regulated and monitored by refuge staff.

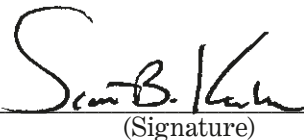
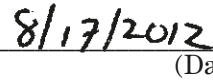
The Service permits commercial photography where it would further outreach, education, or public understanding of the natural environment, refuge resources and management, or the Refuge System and Service's missions. No approvals for a permit would occur until the refuge manager can insure those benefits would result.

As such, all approved commercial wildlife and nature photography will contribute to the goals of the refuge and Refuge System, and will not materially interfere with or detract from the mission of the Refuge System or the purposes for which the refuge was established.

**SIGNATURE:**

Refuge Manager:  (Signature)  (Date)

**CONCURRENCE:**

Regional Chief:  (Signature)  (Date)

**MANDATORY 10 YEAR RE-EVALUATION DATE:**



**LITERATURE CITED:**

- Beale, C. M., and P. Monaghan. 2004. Human disturbance: people as predation-free predators? *Journal of Applied Ecology* 41:335-343.
- Belanger, L., and J. Bedard. 1990. Energetic cost of man-induced disturbance to staging snow geese. *Journal of Wildlife Management*. 54:36-41.
- Burger, J. 1981. Effect of human activity on birds at a coastal bay. *Biological Conservation* 21:231-241.
- Colorado State Parks. 1998. Planning trails with wildlife in mind: a handbook for trail planners prepared by Trails and Wildlife Task Force and Hellmund Associates. 51 pp. Accessed online at: <http://www.fs.fed.us/outdoors/naturewatch/start/planning/Trails-for-Wildlife-Handbk.pdf>.
- Erwin, R. M. 1980. Breeding habitat by colonially nesting water birds in 2 Mid-Atlantic U.S. regions under different regimes of human disturbance. *Biological Conservation*. 18:39-51.
- Hammitt, W. E. and D.N. Cole. 1998. *Wildland Recreation*. John Wiley & Sons, New York, 361pp.
- Henson, P. T., and A. Grant. 1991. The effects of human disturbance on trumpeter swan breeding behavior. *Wildlife Society Bulletin* 19:248-257.
- Havera, S. P., L. R. Boens, M. M. Georgi, and R. T. Shealy. 1992. Human disturbance of waterfowl on Keokuk Pool, Mississippi River. *Wildlife Society Bulletin* 20:290-298.



- Kaiser, M.S. & Fritzell, E.K. 1984. Effects of river recreationists on green-backed heron behavior. *Journal of Wildlife Management* 48, 561-567.
- Kahl, R. 1991. Boating disturbance of canvasbacks during migration at Lake Poygan, Wisconsin. *Wildlife Society Bulletin* 19:242-248.
- Knight, R.L. and D. N. Cole. 1991. Effects of recreational activity on wildlife in wildlands. *Trans. 56th N.A. Wildl. & Nat. Res. Conf.* Pages 238-247.
- Korschen, C. E., L. S. George, and W. L. Green. 1985. Disturbance of diving ducks by boaters on a migrational staging area. *Wildlife Society Bulletin* 13:290-296.
- Miller, S.G., R.L. Knight, and C.K. Miller. 1998. Influence of recreational trails on breeding bird communities. *Ecological Applications* 8:162-169.
- Miller, S.G., R.L. Knight, and C.K. Miller. 2001. Wildlife responses to pedestrians and dogs. *Wildlife Society Bulletin* 29(1): 124-132.
- Morton, J. M., A. C. Fowler, and R. L. Kirkpatrick. 1989. Time and energy budgets of American black ducks in winter. *Journal of Wildlife Management* 53:401-410(also see corrigendum in *J. Wildl. Manage.* 54:683).
- Owen, M. 1973. The management of grassland areas for wintering geese. *Wildfowl*. 24:123-130.
- Ward, D. H., and R. A. Stehn. 1989. Response of brant and other geese to aircraft disturbance at Izembek Lagoon, Alaska. U.S. Fish and Wildlife Service, Alaska Fish and Wildlife Research Center. Final report to the Minerals Management Service. Anchorage, Alaska. 193 pp.
- Williams, G. J., and E. Forbes. 1980. The habitat and dietary preferences of dark-bellied brant geese and widgeon in relation to agricultural management. *Wildfowl*. 31:151-157.



**FINDING OF APPROPRIATENESS OF A REFUGE USE****Refuge Name:** Great Bay National Wildlife Refuge**Use:** Research by Non-Service Personnel

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

<b>Decision criteria:</b>	<b>YES</b>	<b>NO</b>
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes \_\_\_\_\_ No ✓.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** \_\_\_\_\_ **Appropriate** ✓

Refuge Manager: Graham W. Taylor Date: 7/1/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: Shawn Munn Date: 8/2/2012

**A compatibility determination is required before the use may be allowed.**

## **JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE**

**Refuge Name:** Great Bay National Wildlife Refuge

**Use:** Research by Non-Service Personnel

### **NARRATIVE:**

Research conducted by non-U.S. Fish and Wildlife Service (Service) personnel is not identified as a priority public use of the National Wildlife Refuge System (Refuge System) under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. However, research by non-Service personnel is often conducted by colleges and universities; Federal, State, and local agencies; nongovernmental organizations; and qualified members of the general public. Research on Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge) would further the understanding of the natural environment and could be applied to management of the refuge's wildlife. Research by others outside of the Service adds greatly to the information base for refuge managers to make informed decisions.

All research proposals are evaluated for their benefits to the refuge and the Refuge System mission. The refuge manager will issue a special use permit for all approved research projects. All research projects require the principal investigator to provide summary reports of findings and acknowledge the refuge for their participation.

Great Bay Refuge is an unstaffed satellite refuge administered by Parker River Refuge. No additional equipment, facilities, or improvements will be necessary to allow research by non-Service personnel. Projects would primarily include activities such as observing, banding, inventorying, and monitoring wildlife and habitats, and would not harm individual wildlife or result in long term alterations to habitat. Staff time would be required to review research proposals and oversee permitted projects. We expect that conducting these activities will require less than 10 percent of a work-year for one staff member.

Disturbance to wildlife and vegetation by researchers could occur through observation, mist-netting, banding, and accessing the study area by foot. It is possible that direct mortality could result as a by-product of research activities. Mist-netting for example, can cause stress, especially when birds are captured, banded, and weighed. There have been occasional mortalities to these birds, namely when predators, such as raccoons and cats, reach the netted birds before researchers do.

Minimal impact will occur when research projects which are previously approved are carried out according to the stipulations stated in the special use permit issued for each project. Overall, however, allowing well-designed and properly reviewed research to be conducted by non-Service personnel is likely to have very little impact on refuge wildlife populations. If the research project is conducted with professionalism and integrity, potential adverse impacts are likely to be outweighed by the knowledge gained about a species, habitat, or public use.

After evaluating research by non-Service personnel under Service policies, we conclude that the activity is appropriate as it contributes to and supports refuge management, purposes, and goals, and the mission of the Refuge System.

## COMPATIBILITY DETERMINATION

### **USE:**

Research by Non-Service Personnel

### **REFUGE NAME:**

Great Bay National Wildlife Refuge

### **ESTABLISHING AND ACQUISITION AUTHORITY(IES):**

Public Law 102-154, Section 319(d) Department of the Interior and Related Agencies Appropriations Bill, 1992.

### **REFUGE PURPOSE(S):**

Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge) was established to:

- Encourage the natural diversity of plant, fish, and wildlife species within the refuge, and to provide for their conservation and management.
- Protect species listed as endangered or threatened or identified as candidates pursuant to the Endangered Species Act of 1973.
- Preserve and enhance the water quality of aquatic habitat within the refuge.
- Fulfill the international treaty obligations of the United States relating to fish and wildlife.

### **NATIONAL WILDLIFE REFUGE SYSTEM MISSION:**

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.”—National Wildlife Refuge System Improvement Act of 1997 (Public Law 105–57; 111 Stat. 1282)

### **DESCRIPTION OF USE:**

#### **(a) What is the use? Is the use a priority public use?**

The use is research conducted by non-Service personnel. It is not identified as a priority public use of the National Wildlife Refuge System (Refuge System) under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997.

There is much that can be learned from field research within the refuge. Baseline information in biological, geophysical, hydrological, and other fields is still in need of being collected. There are many opportunities for consultants, colleges and universities, and other agencies to obtain permission to conduct critical and noteworthy research on the refuge. Projects would primarily include activities such as observing, banding, inventorying, and monitoring wildlife and habitats, and would not harm individual wildlife or result in long term alterations to habitat.



Two provisions of the National Wildlife Refuge Improvement Act are to “maintain biological integrity, diversity, and environmental health” and to conduct “inventory and monitoring.” Monitoring and research are an integral part of refuge management. Plans and actions based on thorough research and consistent monitoring provide an informed approach to management effects on wildlife and habitat.

Currently, research applicants are required to submit a proposal that outlines the following:

- (1) Objectives of the study.
- (2) Justification for the study.
- (3) Detailed methodology and schedule.
- (4) Potential impacts on refuge wildlife or habitat, including disturbance (short- and long-term), injury, or mortality (this includes a description of measures the researcher will take to reduce disturbance or impacts).
- (5) Research personnel required.
- (6) Costs to refuge, if any.
- (7) Progress reports and end products (i.e., reports, thesis, dissertations, and publications).

Research proposals are reviewed by refuge staff and conservation partners, as appropriate, for approval. Evaluation criteria currently include, but are not limited to, the following:

- Research that will contribute to specific refuge management issues will be given higher priority over other research requests.
- Research that will conflict with other ongoing research, monitoring, or management programs will not be permitted.
- Research projects that can be accomplished off-refuge are less likely to be approved.
- Research that causes undue disturbance or is intrusive will likely not be permitted. Level and type of disturbance will be carefully evaluated when considering a request.
- Refuge evaluation will determine if any effort has been made to minimize disturbance through study design, including considering adjusting location, timing, scope, number of permittees, study methods, number of study sites, etc.
- If staffing or logistics make it impossible for the refuge to monitor researcher activity in a sensitive area, the research request may be denied, depending on the specific circumstances.
- The length of the project will be considered and agreed upon before approval. Projects will be reviewed annually.

**(b) Where would the use be conducted?**

The location of the research will vary depending on the individual research project that is being conducted. The entire refuge is available for scientific research. An individual research project is usually limited to a particular habitat type, plant species, or wildlife species. On occasion, research projects will encompass an assemblage of habitat types, plants or wildlife. The research location will be limited to those areas of the refuge that are absolutely necessary to conduct the research project and that do not create a significant negative impact to refuge operations and wildlife use.

**(c) When would the use be conducted?**

The timing of the research will depend entirely on the individual research project's approved design. Scientific research would be allowed to occur on the refuge throughout the year as long as that use does not present a significant negative impact to wildlife use and management operations. An individual research project could be short-term in design, requiring one or two visits over the course of a few days. Other research projects could be multiple year studies that require daily visits to the study site. The timing of each individual research project will be limited to the minimum required to complete the project. If a research project occurs during the refuge hunt, special precautions will be required and enforced to ensure public health and safety.

**(d) How would the use be conducted?**

The methods of the research will depend entirely on the individual research project that is conducted. The methods and objectives of each research project will be scrutinized well before it will be allowed to occur on the refuge. We will not permit a research project that lacks an approved study plan and protocol, compromises public health and safety, or presents a significant negative impact to wildlife resources or habitats within the refuge. This permitted research use must be regulated and governed by the conditions and other terms of a refuge special use permit. The special use permit will provide any needed protection to individual refuge policies, mission, wildlife populations, and natural habitats. In addition, all research projects require the primary investigator to submit written summary reports of all findings, and acknowledge the refuge staff's participation.

**(e) Why is this use being proposed?**

Research by non-Service personnel is conducted by colleges and universities; Federal, State, and local agencies; nongovernmental organizations; and qualified members of the public. Such studies further our understanding of the refuge's natural environment. Research is therefore an important part of the adaptive management process that often results in improved management of refuge habitats and wildlife populations. Much of the information that research generates can be applied to management practices both on, and adjacent to, the refuge.

The Service encourages and supports research and management studies on refuge lands that will improve and strengthen decisions for managing natural resources. The refuge manager encourages and seeks research that clearly relates to approved refuge objectives, improves habitat management, and promotes adaptive management. Priority research addresses information on better managing the nation's biological resources that are important to agencies of the Department of Interior, the Refuge System, and state fish and wildlife agencies, and that address important management issues or demonstrate techniques for managing species or habitats.

The refuge manager will also consider research for other purposes that may not relate directly to refuge-specific objectives, but contribute to the broader enhancement, protection, use, preservation, or management of native populations of fish, wildlife, and plants, and their natural diversity in the Northeast Region and/or the Atlantic Flyway. All proposals must comply with Service policy on compatibility.

**AVAILABILITY OF RESOURCES:**

Great Bay Refuge is an unstaffed satellite refuge administered by Parker River Refuge. No additional equipment, facilities, or improvements will be necessary to allow research by non-Service personnel. Staff from Parker River Refuge will be required to review research proposals and oversee permitted projects. We expect that conducting these activities will require less than 10 percent of a work-year for one staff member.

**Anticipated costs are:**

Senior Refuge Biologist (GS-12) (review request)—4 days/year = **\$1,900**

Refuge Manager (GS-13) (review and approval)—1 day/year = **\$500**

Law Enforcement Officer (GS-9) (enforcement patrols) —1 day/year = **\$400**

### **ANTICIPATED IMPACTS OF THE USE:**

The Service encourages approved research to further the understanding of the natural resources. Research by other than Service personnel adds greatly to the information base for refuge managers to make proper decisions. Disturbance to wildlife and vegetation by researchers could occur through observation, mist-netting, banding, and accessing the study area by foot. It is possible that direct mortality could result as a by-product of research activities. For example, mist-netting can cause stress, especially when birds are captured, banded, and weighed. There have been occasional mortalities to these birds, namely when predators, such as raccoons and cats, reach the netted birds before researchers do.

Minimal impact will occur when research projects which are previously approved are carried out according to the stipulations stated in the special use permit issued for each project. Overall, however, allowing well designed and properly reviewed research to be conducted by non-Service personnel is likely to have very little impact on refuge wildlife populations. If the research project is conducted with professionalism and integrity, potential adverse impacts are likely to be outweighed by the knowledge gained about an entire species, habitat, or public use.

### **PUBLIC REVIEW AND COMMENT:**

As part of the comprehensive conservation planning process for Great Bay Refuge, this compatibility determination underwent extensive public review, including a comment period of 39 days that followed the release of the draft Comprehensive Conservation Plan and Environmental Assessment.

### **DETERMINATION (CHECK ONE BELOW):**

- ☐ Use is not compatible.
- ☒ Use is compatible with the following stipulations.

### **STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:**

We will require all researchers to submit a detailed research proposal that follows Great Bay Refuge study proposal guidelines (see attachment I) and Service Policy (FWS Refuge Manual Chapter 4, Section 6). Researchers must give us at least 45 days to review proposals before the research begins. If the research involves the collection of wildlife, the refuge must be given 60 days to review the proposal. Researchers must obtain all necessary scientific collecting or other appropriate State and Federal permits before starting the research. We will prioritize and approve proposals based on the need, benefit, compatibility, and funding required for the research. We may ask our regional refuge biologists, other Service divisions, State agencies, or academic experts to review and comment on proposals.

The criteria for evaluating a research proposal, outlined in the “Description of Use” section above, will be used when determining whether a proposed study will be approved on the refuge. If we approve the proposal, we will issue a special use permit. Special use permits will contain specific terms and conditions that the researcher(s) must follow relative to the activities planned (e.g., location, duration, seasonality, etc.) to ensure continued compatibility. All refuge rules and regulations must be followed unless alternatives are otherwise accepted in writing by refuge management. The permit will identify a schedule for annual progress reports and the submission of a final report or scientific paper.

The permit will also stipulate measures to minimize potential impacts (e.g., reduce the numbers of researchers entering an area, restrict research in specified areas) to include as part of the study design. For example, sensitive wildlife habitat areas would be avoided unless sufficient protection from research activities (i.e., disturbance, collection, capture, and handling) is implemented to limit the area and/or wildlife potentially

impacted by the proposed research. Where appropriate, some areas may be temporarily or seasonally closed so that research would be permitted when impacts to wildlife and habitat are less of a concern. Research activities will be modified to avoid harm to sensitive wildlife and habitat when unforeseen impacts arise.

Refuge staff will monitor researcher activities for potential impacts to the refuge and for compliance with conditions on the special use permit. The refuge manager may determine that previously approved research and special use permits be terminated due to observed impacts. The refuge manager will also have the ability to cancel a special use permit if the researcher is not in compliance with the stated conditions.

We will expect researchers to submit a final report to the refuge on completing their work. For long-term studies, we may also require interim progress reports. We also expect that research will be published in peer-reviewed publications. All reports, presentations, posters, articles or other publications will acknowledge the Refuge System and Great Bay Refuge as partners in the research. We have this requirement to ensure that the research community, partners, and the public understand that the research could not have been conducted without the refuge having been established, its operational support, and that of the Refuge System.

### **JUSTIFICATION:**

This program as described is determined to be compatible. Any potential negative impacts of research activities on the resources of the refuge will be minimized by the restrictions included in the special use permit special conditions. In addition, the research study design and researcher activities will be regulated and monitored by refuge staff.

The Service encourages approved research to further our understanding of refuge natural resources and management. Research by non- Service personnel adds greatly to the information base for refuge managers to make proper decisions. Research conducted by non-Service personnel will contribute to the goals of the refuge and Refuge System, and will not materially interfere with or detract from the mission of the Refuge System or the purposes for which the refuge was established.

### **SIGNATURE:**

Refuge Manager:

*Greta D. Taylor*  
(Signature)

*July 1, 2012*  
(Date)

### **CONCURRENCE:**

Regional Chief:

*Sean B. Kane*  
(Signature)

*8/17/2012*  
(Date)

### **MANDATORY 10 YEAR RE-EVALUATION DATE:**

*8/17/2022*

### **LITERATURE CITED:**

U.S. Fish and Wildlife Service. 1985. Refuge Manual. Washington, D.C.: U.S. Government Printing Office.

## **ATTACHMENT I.**

### *Great Bay National Wildlife Refuge Study Proposal Guidelines*

A study proposal is a justification and description of the work to be done, and includes cost and time requirements. The proposals must be specific enough to serve as blueprints for the investigation. They must spell out in advance systematic plans for the investigation at a level of detail commensurate with the cost and scope of the project and the needs of management. Please submit proposals electronically as a Microsoft® Word® document or hard copy to the refuge manager.

The following list provides a general outline of first-order headings/sections for study proposals.

- Cover Page
- Table of Contents (for longer proposals)
- Abstract
- Statement of Issue
- Literature Summary
- Objectives/Hypotheses
- Study Area
- Methods and Procedures
- Quality Assurance/Quality Control
- Specimen Collections
- Deliverables
- Special Requirements, Concerns, Necessary Permits
- Literature Cited
- Peer Review
- Budget
- Personnel and Qualifications

#### *Cover Page*

The cover page must contain the following information.

- Title of proposal.
- Current date.
- Investigator(s)—name, title, organizational affiliation, address, telephone and fax numbers and e-mail address of all investigators or cooperators.
- Proposed starting date.
- Estimated completion date.
- Total funding support requested from the U.S. Fish and Wildlife Service.
- Signatures of principal investigator(s) and other appropriate institutional officials.

#### *Abstract*

The abstract should contain a short summary of the proposed study, including reference to major points in the sections “Statement of Issue,” “Objectives,” and “Methods and Procedures.”

#### *Statement of Issue*

Provide a clear precise summary of the problem to be addressed and the need for its solution. This section should include statements of the importance, justification, relevance, timeliness, generality, and contribution of the study. Describe how any products will be used, including any anticipated commercial use. What is the estimated probability of success of accomplishing the objective(s) within the proposed timeframe?

#### *Literature Summary*

This section should include a thorough but concise literature review of current and past research that pertains to the proposed research, especially any pertinent research conducted at the Great Bay National Wildlife Refuge. A discussion of relevant legislation, policies, and refuge planning and management history, goals, and objectives should also be included.



### *Objectives/Hypotheses*

A very specific indication of the proposed outcomes of the project should be stated as objectives or hypotheses to be tested. Project objectives should be measurable. Provide a brief summary of what information will be provided at the end of the study and how it will be used in relation to the problem. These statements should flow logically from the statement of issue and directly address the management problem.

Establish data quality objectives in terms of precision, accuracy, representativeness, completeness, and comparability as a means of describing how good the data need to be to meet the project's objectives.

### *Study Area*

Provide a detailed description of the geographic area(s) to be studied and include a clear map delineating the proposed study area(s) and showing specific locations where work will occur.

### *Methods and Procedures*

This section should describe as precisely as possible, how the objectives will be met or how the hypotheses will be tested. Include detailed descriptions and justifications of the field and laboratory methodology, protocols, and instrumentation. Explain how each variable to be measured directly addresses the research objective/hypothesis. Describe the experimental design, population, sample size, and sampling approach (including procedures for sub-sampling). Summarize the statistical and other data analysis procedures to be used. List the response variables and tentative independent variables or covariates. Describe the experimental unit(s) for statistical analysis. Also include a detailed project time schedule that includes start, fieldwork, analysis, reporting, and completion dates.

### *Quality Assurance/Quality Control*

Adequate quality assurance/quality control procedures help ensure that data and results are:

- Credible and not an artifact of sampling or recording errors.
- Of known quality.
- Able to stand up to external scientific scrutiny.
- Accompanied by detailed method documentation.

Describe the procedures to be used to ensure that data meet defined standards of quality and program requirements, errors are controlled in the field, laboratory, and office, and data are properly handled, documented, and archived. Describe the various steps (e.g., personnel training, calibration of equipment, data verification and validation) that will be used to identify and eliminate errors introduced during data collection (including observer bias), handling, and computer entry. Identify the percentage of data that will be checked at each step.

### *Specimen Collections*

Clearly describe the kind (e.g., species), numbers, sizes, and locations of animals, plants, rocks, minerals, or other natural objects to be sampled, captured, or collected. Identify the reasons for collecting, the intended use of all the specimens to be collected, and the proposed disposition of collected specimens. For those specimens to be retained permanently as voucher specimens, identify the parties responsible for cataloging, preservation, and storage, as well as the proposed repository.

### *Deliverables*

The proposal must indicate the number and specific format of hard and/or electronic media copies to be submitted for each deliverable. The number and format will reflect the needs of the refuge and the refuge manager. Indicate how many months after the project is initiated (or the actual anticipated date) that each deliverable will be submitted. Deliverables are to be submitted or presented to the refuge manager.

Deliverables that are required are as follows.

### *Reports and Publications*

Describe what reports will be prepared and the timing of reports. Types of reports required in fulfillment of natural and social science study contracts or agreements include:

- (1) Progress report(s) (usually quarterly, semiannually, or annually; may be required).
- (2) Draft final and final report(s) (always required).

A final report must be submitted in addition to a thesis or dissertation (if applicable) and all other identified deliverables. Final and draft final reports should follow refuge guidelines (attachment I).

In addition, investigators are encouraged to publish the findings of their investigations in refereed professional, scientific publications and present findings at conferences and symposia. The refuge manager appreciates opportunities to review manuscripts in advance of their publication.

### *Data Files*

Provide descriptions of any spatial (Geographic Information Systems [GIS]) and non-spatial data files that will be generated and submitted as part of the research. Non-spatial data must be entered onto CD-ROMs in Microsoft Access or Microsoft Excel. Spatial data, which includes Global Positioning System (GPS)-generated files, must be in a format compatible with the refuge's GIS system (ArcGIS 8 or 9, Arcview 3.3, or e00 format). All GIS data must be in UTM 19, NAD 83. A condition of the permit will be that the Service has access to, and may use, all GIS information generated for future mapping and management.

### *Metadata*

For all non-spatial and spatial data sets or information products, documentation of information (metadata) describing the extent of data coverage and scale, the history of where, when, and why the data were collected, who collected the data, the methods used to collect, process, or modify/ transform the data, and a complete data dictionary must also be provided as final deliverables. Spatial metadata must conform to Service (FGDC) metadata standards.

### *Oral Presentations*

Three types of oral briefings should be included: pre-study, annual, and closeout. These briefings will be presented to refuge staff and other appropriate individuals and cooperators. In addition, investigators should conduct periodic informal briefings with refuge staff throughout the study whenever an opportunity arises. During each refuge visit, researchers should provide verbal updates on project progress. Frequent dialogue between researchers and refuge staff is an essential element of a successful research project.

### *Specimens and Associated Project Documentation*

A report on collection activities, specimen disposition, and the data derived from collections must be submitted to the refuge following refuge guidelines.

### *Other:*

Researchers must provide the refuge manager with all of the following:

- (1) Copies of field notes/notebooks/datasheets.
- (2) Copies of raw data (in digital format), including GIS data, as well as analyzed data.
- (3) Copies of all photos (digital photos preferred), slides, videos, and films.
- (4) Copies of any reports, theses, dissertations, publications or other material (such as news articles) resulting from studies conducted on refuge.
- (5) Detailed protocols used in study.
- (6) Aerial photographs.

- (7) Maps/GIS data.
- (8) Interpretive brochures and exhibits.
- (9) Training sessions (where appropriate).
- (10) Survey forms.
- (11) Value-added software, software developed, and models.

Additional deliverables may be required of specific studies.

### *Special Requirements, Permits, and Concerns*

Provide information on the following topics where applicable. Attach copies of any supporting documentation that will facilitate processing of your application.

#### *Refuge Assistance*

Describe any refuge assistance needed to complete the proposed study, such as use of equipment or facilities or assistance from refuge staff. It is important that all equipment, facilities, services, and logistical assistance expected to be provided by the Service be specifically identified in this section so all parties are in clear agreement before the study begins.

#### *Ground Disturbance*

Describe the type, location, area, depth, number, and distribution of expected ground-disturbing activities, such as soil pits, cores, or stakes. Describe plans for site restoration of significantly affected areas.

Proposals that entail ground disturbance may require an archaeological survey and special clearance prior to approval of the study. You can help reduce the extra time that may be required to process such a proposal by including identification of each ground disturbance area on a U.S. Geological Survey 7.5-minute topographic map.

#### *Site Marking and/or Animal Marking*

Identify the type, amount, color, size, and placement of any flagging, tags, or other markers needed for site or individual resource (e.g., trees) identification and location. Identify the length of time it is needed and who will be responsible for removing it. Identify the type, color, and placement of any tags placed on animals (see special use permit for stipulations on marking and handling of animals).

#### *Access to Study Sites*

Describe the proposed method and frequency of travel to and within the study site(s). Explain any need to enter restricted areas. Describe the duration, location, and number of participants, and approximate dates of site visits.

#### *Use of Mechanized and Other Equipment*

Describe any vehicles, boats, field equipment, markers, or supply caches by type, number, and location. You should explain the need to use these materials and how long they are to be left in the field.

#### *Safety*

Describe any known potentially hazardous activities, such as electro-fishing, scuba diving, whitewater boating, aircraft use, wilderness travel, and wildlife capture, handling, or immobilization.

#### *Chemical Use*

Identify chemicals and hazardous materials that you propose using within the refuge. Indicate the purpose, method of application, and amount to be used. Describe plans for storage, transfer, and disposal of these materials and describe steps to remediate accidental releases into the environment. Attach copies of Material Safety Data Sheets (MSDS).

### *Animal Welfare*

If the study involves vertebrate animals, describe your protocol for any capture, holding, marking, tagging, tissue sampling, or other handling of these animals (including the training and qualifications of personnel relevant to animal handling and care). If your institutional animal welfare committee has reviewed your proposal, please include a photocopy of their recommendations. Describe alternatives considered, and outline procedures to be used to alleviate pain or distress. Include contingency plans to be implemented in the event of accidental injury to or death of the animal. Include State and Federal permits. Where appropriate, coordinate with and inform State natural resource agencies.

### *Literature Cited*

List all reports and publications cited in the proposal.

### *Peer Review*

Provide the names, titles, addresses, and telephone numbers of individuals with subject-area expertise who have reviewed the research proposal. If the reviewers are associated with the investigator's research institution or if the proposal was not reviewed, please provide the names, titles, addresses, and telephone numbers of three to five potential subject-area reviewers who are not associated with the investigator's institution. These individuals will be asked to provide reviews of the proposal, progress reports, and the draft final report.

### *Budget*

The budget must reflect both funding and assistance that will be requested from the Service and the cooperator's contributions on an identified periodic (usually annual) basis.

### *Personnel Costs*

Identify salary charges for principal investigator(s), research assistant(s), technician(s), clerical support, and others. Indicate period of involvement (hours or months) and pay rate charged for services. Be sure to include adequate time for data analysis and report writing and editing.

### *Fringe Benefits*

Itemize fringe benefit rates and costs.

### *Travel*

Provide separate estimates for fieldwork and meetings. Indicate number of trips, destinations, estimated miles of travel, mileage rate, air fares, days on travel, and daily lodging and meals charges. Vehicle mileage rate cannot exceed standard government mileage rates if Federal funds are to be used. Charges for lodging and meals are not to exceed the maximum daily rates set for the locality by the Federal Government (contact Great Bay Refuge for appropriate rates).

### *Equipment*

Itemize all equipment to be purchased or rented and provide a brief justification for each item costing more than \$1,000. Be sure to include any computer-related costs. For proposals funded under a Service agreement or contract, the refuge reserves the right to transfer the title of purchased equipment with unit cost of \$1,000 or more to the Federal Government following completion of the study. These items should be included as deliverables.

### *Supplies and Materials*

Purchases and rentals under \$1,000 should be itemized as much as is reasonable.

### *Subcontract or Consultant Charges*

All such work must be supported by a subcontractor's proposal also in accordance with these guidelines.

### *Specimen Collections*

Identify funding requirements for the cataloging, preservation, storage, and analyses of any collected specimens that will be permanently retained.

### *Printing and Copying*

Include costs for preparing and printing the required number of copies of progress reports, the draft final report, and the final report. In general, a minimum of two copies of progress reports (usually due quarterly, semiannually, or as specified in agreement), the draft final report, and the final report are required.

### *Indirect Charges*

Identify the indirect cost (overhead) rate and charges and the budget items to which the rate is applicable.

### *Cooperator's Contributions*

Show any contributing share of direct or indirect costs, facilities, and equipment by the cooperating research institution.

### *Outside Funding*

List any outside funding sources and amounts.

### *Personnel and Qualifications*

List the personnel who will work on the project and indicate their qualifications, experience, and pertinent publications. Identify the responsibilities of each individual and the amount of time each will devote. A full vita or resume for each principal investigator and any consultants should be included here.

## **Interim Final Report Guidelines**

Draft final and final reports should follow Journal of Wildlife Management format, and should include the following sections.

- Title Page
- Abstract
- Introduction/Problem Statement
- Study Area
- Methods (including statistical analyses)
- Results
- Discussion
- Management Implications
- Management Recommendations
- Literature Cited





**FINDING OF APPROPRIATENESS OF A REFUGE USE****Refuge Name:** Great Bay National Wildlife Refuge**Use:** Walking, Hiking, Cross Country Skiing, and Snowshoeing

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

<b>Decision criteria:</b>	<b>YES</b>	<b>NO</b>
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, Tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ["no" to (a)], there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ["no" to (b), (c), or (d)] may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes \_\_\_\_\_ No ✓.

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** \_\_\_\_\_ **Appropriate** ✓

Refuge Manager: Gretchen W. Taylor Date: 7/1/2012

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence:

Refuge Supervisor: Sharon M. Murre Date: 8/2/2012

**A compatibility determination is required before the use may be allowed.**

## **JUSTIFICATION FOR A FINDING OF APPROPRIATENESS OF A REFUGE USE**

**Refuge Name:** Great Bay National Wildlife Refuge

**Use:** Walking, Hiking, Cross Country Skiing, and Snowshoeing

### **NARRATIVE:**

To comply with 2006 U.S. Fish and Wildlife Service (Service) policy on appropriateness, we are evaluating all non-priority public uses for Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge). Walking, hiking, cross-country skiing, and snowshoeing are not explicitly identified as a priority public uses of the National Wildlife Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997. However, we consider these uses appropriate as they allow refuge visitors the least impacting mode of transportation to participate in wildlife observation, photography, and environmental education, which are priority public uses.

The presence of people walking, hiking, skiing, and snowshoeing could result in some disturbance to wildlife located in habitats adjacent to the trail system. Recreational trail use has been shown to cause disturbance to wildlife up to 330 feet (100 meters) from trails (Taylor and Knight 2003). The use of the trails could lead to soil compaction causing some tree roots to be exposed if they are close to the ground surface. The boardwalk and refuge signs encourage visitors to stay on the trail to minimize disturbance to wildlife and surrounding vegetation. Other impacts in violation of refuge regulations such as littering, picking/collecting vegetation or illegal take of wildlife could occur. Refuge staff believe that with the proper management, walking, hiking, skiing, and snowshoeing will not result in any short- or long-term impacts that will adversely affect the purpose of the refuge or the mission of the National Wildlife Refuge System.

To minimize wildlife disturbance and environmental damage, refuge visitors are required to remain on designated trails. Trails are monitored and maintained by the refuge volunteers and refuge staff. One trail is almost entirely boardwalked and is wheelchair accessible. The other trail is predominantly of earth and some gravel. The trail surfaces are maintained each year as necessary.

One of the goals of the National Wildlife Refuge System is to provide high-quality wildlife viewing opportunities for the public. Allowing the use of the trail system by persons engaging in walking, hiking, cross country skiing, and snowshoeing will provide visitors the chance to view wildlife. This activity promotes an appreciation for the continued conservation and protection of wildlife and habitat. Walking, hiking, cross country skiing, and snowshoeing would not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the refuge was established.

### **LITERATURE CITED:**

Taylor, A. R., and R. L. Knight. 2003. Wildlife Responses to Recreation and Associated Visitor Perceptions. *Ecological Applications*, 13 (4), 2003, pp. 951-963.

## **COMPATIBILITY DETERMINATION**

### **USE:**

Walking, Hiking, Cross Country Skiing, and Snowshoeing

### **REFUGE NAME:**

Great Bay National Wildlife Refuge

### **ESTABLISHING AND ACQUISITION AUTHORITY(IES):**

Public Law 102-154, Section 319(d) Department of the Interior and Related Agencies Appropriations Bill, 1992.

### **REFUGE PURPOSE(S):**

Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge) was established:

- To encourage the natural diversity of plant, fish, and wildlife species within the refuge, and to provide for their conservation and management.
- To protect species listed as endangered or threatened or identified as candidates pursuant to the Endangered Species Act of 1973.
- To preserve and enhance the water quality of aquatic habitat within the refuge.
- To fulfill the international treaty obligations of the United States relating to fish and wildlife.

### **NATIONAL WILDLIFE REFUGE SYSTEM MISSION:**

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.”—National Wildlife Refuge System Improvement Act of 1997 (Public Law 105–57; 111 Stat. 1282)

### **DESCRIPTION OF USE:**

#### **(a) What is the use? Is the use a priority public use?**

The uses are walking, hiking, cross country skiing, and snowshoeing. These are not priority public uses of the National Wildlife Refuge System (Refuge System) under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), and the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). However, refuge staff believe by allowing these activities, that the participants will be positively exposed to the refuge and the Refuge System. This exposure may lead to a better understanding of the importance of the Refuge System to the American people. The aforementioned activities have occurred on the refuge for many years. Also, many people engaged in priority public uses at Great Bay Refuge, such as hunting, wildlife observation and photography, and interpretation, access the refuge and its public use facilities through these uses.

**(b) Where would the use be conducted?**

These uses will primarily be conducted along the two public use trails (Ferry Way Trail and Upper Peverly Trail). Occasional refuge-organized programs or events may also occur in portions of the refuge normally closed to the public.

**(c) When would the use be conducted?**

We will allow these uses daily, year-round, from sunrise to sunset, unless a conflict with a trail maintenance activity or an extenuating circumstance necessitates our deviating from normal operating hours. Such circumstances include, but are not limited to, the 2-day controlled deer hunt, and closures for snow and ice storms or other events affecting human safety.

**(d) How would the use be conducted?**

We will allow these uses on the 2-mile Ferry Way Trail and the 0.5-mile Upper Peverly Trail. These uses afford pedestrian access for wildlife observation and other priority public uses, as noted below in section (e). To support these activities, there is currently a map at the information kiosk at the public parking area where both trails originate, as well a general information brochure that include a map showing the trails. This information is also available on the refuge Web site.

Visitors are required to remain on the designated trail system to minimize environmental damage and prevent accidents. Collecting of any kind is not allowed, nor is disturbing or feeding wildlife. Trails are monitored and maintained by refuge volunteers to provide a safe and quality visitor experience. The trail surfaces are maintained each year, as necessary.

Refuge visitors may use bicycles to access the refuge, but bicycles are not allowed on any of the refuge trails. Similarly, jogging is also not allowed on refuge trails, as indicated in the finding of appropriateness for jogging.

**(e) Why is this use being proposed?**

These uses support wildlife observation and other priority public uses on Great Bay and most national wildlife refuges. Refuge staff believe, by allowing these activities, that the participants will be positively exposed to the refuge and the Refuge System. This exposure may lead to a better understanding of the importance of the Refuge System to the American people and to their support for refuge acquisition and management.

**AVAILABILITY OF RESOURCES:**

The resources necessary to provide and administer this use are available within current and anticipated refuge budgets. Trail maintenance is provided by refuge volunteers.

Visitor Services Specialist (GS-12)—5 days/year = \$2,375

Outdoor Recreation Planner (GS-9)—10 days/year = \$4,000

Law Enforcement (GS-9)—5 days/year = \$2,000

**ANTICIPATED IMPACTS OF THE USE:**

The presence of people walking, hiking, skiing, and snowshoeing could result in some disturbance to wildlife located in habitats adjacent to the trail system.

*Direct Effects*

Direct impacts are those where the activity has an immediate effect on wildlife and/or habitats.

Trail use may lead to trampling of vegetation adjacent to the trail or compaction of soil and leaf litter. These impacts are generally localized to areas adjacent to trails or areas of frequent off-trail use. Impacts of off-trail use can include a reduction in the density of plants near trails, soil compaction, increased erosion,



and damage to, or killing of, plants (Colorado State Parks 1998). To reduce the potential for these types of disturbance, markers and refuge boundary signs encourage trail users to stay on the trail to minimize effects on surrounding vegetation.

The presence of humans walking along trails can directly disturb migratory birds and other wildlife species. Wildlife often respond to human presence by departing from the disturbed site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschen et al. 1985, Henson and Grant 1991, Kahl 1991, Klein 1993), using of sub-optimal habitat or non-preferred habitat (Erwin 1980, Williams and Forbes 1980), altering their behavior (Burger 1981, Korschen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increasing their energy expenditure (Morton et al. 1989, Belanger and Bedard 1990). Human disturbances can also decrease reproductive success by causing nest abandonment, decline in parental care, altering feeding schedules, and other stresses (Colorado State Parks 1998). It can cause shifts in habitat use, lead to abandonment of habitat, and increase energy demands in affected wildlife (Knight and Cole 1991). Hammitt and Cole (1998) conclude that the frequent presence of humans in natural areas can dramatically change the behavior of some wildlife species.

Wildlife responses to human disturbance vary by species, and by the type, level, frequency, duration, and time of year of the human use. For example generalist species, which thrive in disturbed areas, are often more abundant along trails than specialist species that are more sensitive to human disturbance (Colorado State Parks 1998). Adverse impacts also tend to increase as user groups increase in size (Beale and Monaghan 2004).

The impact of walking along trails can have impacts even outside of the immediate trail corridor (Miller et al. 2001). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. They also found that nest predation was also greater near trails (Miller et al. 1998).

### *Indirect Effects*

When people move from one area to another, they can be vectors for the seeds or other propagules of invasive plants. Once established, invasive plants can outcompete native plants, thereby altering habitats and indirectly impacting wildlife. The threat of invasive plants establishing themselves will always be an issue that requires monitoring.

### *Cumulative Effects*

Effects that are minor when we consider them separately but may be important when we consider them collectively are cumulative effects. The principal concerns are repeated disturbances of birds that are nesting, foraging, or resting. Opening refuge land to public use can often result in litter, vandalism, or other illegal activities.

Our observations and knowledge of the areas involved provide no evidence that, cumulatively, these proposed wildlife-dependent uses will have an unacceptable effect on the wildlife resource. Although we do not expect a substantial increase in the cumulative effects of public use in the near term, it will be important for refuge staff to monitor public use and respond, if necessary, to conserve the high-quality wildlife resources on the refuge.

We expect no additional effects from wildlife observation, wildlife photography, environmental education or interpretation. Refuge staff will monitor and evaluate the effects of public use in collaboration with volunteers to discern and respond to unacceptable impacts on wildlife or habitats.

## **PUBLIC REVIEW AND COMMENT:**

As part of the comprehensive conservation planning process for Great Bay Refuge, this compatibility determination underwent extensive public review, including a comment period of 39 days that followed the release of the draft Comprehensive Conservation Plan and Environmental Assessment.

**DETERMINATION (CHECK ONE BELOW):**

- ☐ Use is not compatible.
- ☒ Use is compatible with the following stipulations.

**STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:**

- To minimize or avoid negative impacts to wildlife and habitat.
- Harassment, baiting, playback tapes, or electronic calls are not allowable methods to attract wildlife for observation or photography (this does not necessarily apply to management activities, e.g., approved research or surveys, which are evaluated on a case-by-case basis).
- Collecting of any kind is prohibited, as described in the finding of appropriateness for berry picking, mushroom collecting, and flower picking (this does not necessarily apply to management activities, e.g., approved research or surveys, which are evaluated on a case-by-case basis).
- Stay on trails unless authorized with permit or attending a refuge program.

**JUSTIFICATION:**

The Service and the National Wildlife Refuge System maintain goals of providing opportunities to view wildlife. Allowing the use of the trail system by persons engaging in walking, hiking, cross country skiing, and snowshoeing will provide visitors the chance to view wildlife. This activity promotes an appreciation for the continued conservation and protection of wildlife and habitat. Walking, hiking, cross country skiing, and snowshoeing would not materially interfere with or detract from the mission of the National Wildlife Refuge System or the purposes for which the refuge was established.

**SIGNATURE:**

Refuge Manager:

Adam W. Taylor  
(Signature)

July 1, 2012  
(Date)

**CONCURRENCE:**

Regional Chief:

Scott B. Kahn  
(Signature)

8/17/2012  
(Date)

**MANDATORY 10 YEAR RE-EVALUATION DATE:**

8/17/2022

**LITERATURE CITED:**

Beale, C. M., and P. Monaghan. 2004. Human disturbance: people as predation-free predators? *Journal of Applied Ecology* 41:335-343.

Belanger, L., and J. Bedard. 1990. Energetic cost of man-induced disturbance to staging snow geese. *Journal of Wildlife Management*. 54:36-41.

- Burger, J. 1981. Effect of human activity on birds at a coastal bay. *Biological Conservation* 21:231-241.
- Colorado State Parks. 1998. Planning trails with wildlife in mind: a handbook for trail planners prepared by Trails and Wildlife Task Force and Hellmund Associates. 51 pp. Accessed online at: <http://www.fs.fed.us/outdoors/naturewatch/start/planning/Trails-for-Wildlife-Handbk.pdf>.
- Erwin, R. M. 1980. Breeding habitat by colonially nesting water birds in 2 Mid-Atlantic U.S. regions under different regimes of human disturbance. *Biological Conservation*. 18:39-51.
- Hammitt, W. E. and D.N. Cole. 1998. *Wildland Recreation*. John Wiley & Sons, New York, 361pp.
- Henson, P. T., and A. Grant. 1991. The effects of human disturbance on trumpeter swan breeding behavior. *Wildlife Society Bulletin* 19:248-257.
- Havera, S. P., L. R. Boens, M. M. Georgi, and R. T. Shealy. 1992. Human disturbance of waterfowl on Keokuk Pool, Mississippi River. *Wildlife Society Bulletin* 20:290-298.
- Kaiser, M.S. & Fritzell, E.K. 1984. Effects of river recreationists on green-backed heron behavior. *Journal of Wildlife Management* 48, 561-567.
- Kahl, R. 1991. Boating disturbance of canvasbacks during migration at Lake Poygan, Wisconsin. *Wildlife Society Bulletin* 19:242-248.
- Knight, R.L. and D. N. Cole. 1991. Effects of recreational activity on wildlife in wildlands. *Trans. 56th N.A. Wildl. & Nat. Res. Conf.* Pages 238-247.
- Korschen, C. E., L. S. George, and W. L. Green. 1985. Disturbance of diving ducks by boaters on a migrational staging area. *Wildlife Society Bulletin* 13:290-296.
- Miller, S.G., R.L. Knight, and C.K. Miller. 1998. Influence of recreational trails on breeding bird communities. *Ecological Applications* 8:162-169.
- Miller, S.G., R.L. Knight, and C.K. Miller. 2001. Wildlife responses to pedestrians and dogs. *Wildlife Society Bulletin* 29(1): 124-132.
- Morton, J. M., A. C. Fowler, and R. L. Kirkpatrick. 1989. Time and energy budgets of American black ducks in winter. *Journal of Wildlife Management* 53:401-410(also see corrigendum in *J. Wildl. Manage.* 54:683).
- Owen, M. 1973. The management of grassland areas for wintering geese. *Wildfowl*. 24:123-130.
- Ward, D. H., and R. A. Stehn. 1989. Response of brant and other geese to aircraft disturbance at Izembek Lagoon, Alaska. U.S. Fish and Wildlife Service, Alaska Fish and Wildlife Research Center. Final report to the Minerals Management Service. Anchorage, Alaska. 193 pp.
- Williams, G. J., and E. Forbes. 1980. The habitat and dietary preferences of dark-bellied brant geese and widgeon in relation to agricultural management. *Wildfowl*. 31:151-157.



## **COMPATIBILITY DETERMINATION**

### **USE:**

Wildlife Observation and Photography, Environmental Education, and Interpretation

### **REFUGE NAME:**

Great Bay National Wildlife Refuge

### **ESTABLISHING AND ACQUISITION AUTHORITY(IES):**

Public Law 102-154, Section 319(d) Department of the Interior and Related Agencies Appropriations Bill, 1992.

### **REFUGE PURPOSE(S):**

Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge) was established to:

- Encourage the natural diversity of plant, fish, and wildlife species within the refuge, and to provide for their conservation and management.
- Protect species listed as endangered or threatened or identified as candidates pursuant to the Endangered Species Act of 1973.
- Preserve and enhance the water quality of aquatic habitat within the refuge.
- Fulfill the international treaty obligations of the United States relating to fish and wildlife.

### **NATIONAL WILDLIFE REFUGE SYSTEM MISSION:**

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.”—National Wildlife Refuge System Improvement Act of 1997 (Public Law 105–57; 111 Stat. 1282)

### **DESCRIPTION OF USE:**

#### **(a) What is the use? Is the use a priority public use?**

The uses are wildlife observation and photography, environmental education, and interpretation. They are priority public uses of the National Wildlife Refuge System (Refuge System), under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997.

#### **(b) Where would the uses be conducted?**

These uses will primarily be conducted along the two public use trails (Ferry Way Trail and Upper Peverly Trail). Occasional refuge-organized programs or events may also occur in portions of the refuge normally closed to the public.



This CCP will enhance opportunities by investigating the possibility of a trail on the Fabyan Point property with an observation platform; other possible observation platforms along the Ferry Way Trail; a spur trail off the Refuge entrance road connecting to the Ferry Way Trail, and converting the Upper Peverly Trail to boardwalk to make it wheelchair accessible. The refuge will also investigate new partnerships with area schools to enhance outreach and education efforts on the refuge.

**(c) When would the uses be conducted?**

These uses will be allowed daily, year-round, from sunrise to sunset, unless a conflict with a trail maintenance activity or an extenuating circumstance necessitates our deviating from those procedures. Examples are the 2-day controlled deer hunt, and closures for snow and ice storms or other events affecting human safety.

**(d) How would the uses be conducted?**

We will allow wildlife observation and photography, environmental education and interpretation on the 2-mile Ferry Way Trail and the 0.5-mile Upper Peverly Trail. To support these activities, there is currently a map at the information kiosk at the public parking area where both trails originate, as well a general information brochure that include a map showing the trails. This information is also available on the refuge Web site. Horseback riding is not allowed on the refuge. Motorized vehicles and bicycles are not allowed beyond the public entrance road and parking lot. Access on trails is restricted to pedestrians only (except visitors using wheelchairs). Most visitors engaged in these uses are either walking, hiking, cross country skiing, or snowshoeing on refuge trails. The refuge also offers chaperoned, interpretive bus tours of the refuge up to 10 times a year. During these trips, refuge staff and/or volunteers drive a group of individuals by bus to various areas of the refuge and present interpretive and educational information. These bus tours occur on public and refuge administration roads; they do not involve driving offroad.

**(e) Why are these uses being proposed?**

The Refuge System Improvement Act defines wildlife observation, photography, environmental education and interpretation as priority public uses that, if compatible, are to receive our enhanced consideration over other general public uses. Authorizing these uses will produce better-informed public advocates for Service programs.

These uses will provide opportunities for visitors to observe and learn about wildlife and wild lands at their own pace in an unstructured environment, and observe wildlife in their natural habitats firsthand. They will provide visitors with compatible educational and recreational opportunities to enjoy refuge resources and gain better understanding and appreciation of wildlife, wild lands ecology, the relationships of plant and animal populations in an ecosystem, and wildlife management. They will enhance public understanding of ecological concepts, enable the public to better understand the problems facing our wildlife and wild lands resources, help them realize what effect the public has on wildlife resources, learn about the Service's role in conservation, and better understand the biological facts upon which we base Service management programs.

Professional and amateur photographers alike will gain opportunities to photograph wildlife in its natural habitat (see separate finding of appropriateness and compatibility determination for "Commercial Wildlife and Nature Photography"). Those opportunities obviously will increase the publicity and advocacy of Service programs. These uses will provide wholesome, safe, outdoor recreation in a scenic setting, and entice those who come strictly for recreational enjoyment to participate in the educational facets of our public use program and become advocates for the refuge and the Service.

## **AVAILABILITY OF RESOURCES:**

Great Bay Refuge is an unstaffed satellite refuge administered by Parker River Refuge. No additional equipment, facilities, or improvements will be necessary to allow research by non-Service personnel. Staff from Parker River Refuge would be required to review research proposals and oversee permitted projects. We expect that conducting these activities will require less than 10 percent of a work-year for one staff member.

**Anticipated costs are:**

Senior Visitor Services Specialist (GS-12) —6 days/year = \$2,850

Refuge Manager (GS-13)—5 days/year = \$2,500

Outdoor Recreation Planner (GS-9)—5 days/year = \$2,000

Law Enforcement Officer (GS-9) (enforcement patrols) 6 days/year = \$2,400

To support these uses, we plan to construct the following new facilities. Estimated costs for these facilities are partly derived from the Service's Region 5 Construction and Rehabilitation Cost Estimating Guide.

Upper Peverly Trail boardwalk	\$40,000
Ferry Way Trail observation platforms	\$10,000
Fabyan Point Trail and observation platform	\$55,000

**ANTICIPATED IMPACTS OF THE USE:**

These public uses can directly and indirectly impact wildlife and their habitats on the refuge. Visitors engaged in these uses are usually walking or taking photographs along existing refuge trails.

*Direct Effects*

Direct impacts are those where the activity has an immediate effect on wildlife and/or habitats.

Trail use may lead to trampling of vegetation adjacent to the trail or compaction of soil and leaf litter. These impacts are generally localized to areas adjacent to trails or areas of frequent off-trail use. Impacts of off-trail use can include a reduction in the density of plants near trails, soil compaction, increased erosion, and damage or killing of plants (Colorado State Parks 1998). To reduce the potential for these types of disturbance, markers and refuge boundary signs encourage trail users to stay on the trail to minimize effects on surrounding vegetation.

The presence of humans walking along trails can directly disturb migratory birds and other wildlife species. Wildlife often respond to human presence by departing from the disturbed site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschen et al. 1985, Henson and Grant 1991, Kahl 1991, Klein 1993), using of sub-optimal habitat or non-preferred habitat (Erwin 1980, Williams and Forbes 1980), altering their behavior (Burger 1981, Korschen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993), and increasing their energy expenditure (Morton et al. 1989, Belanger and Bedard 1990). Human disturbances can also decrease reproductive success by causing nest abandonment, decline in parental care, altering feeding schedules, and other stresses (Colorado State Parks 1998). It can cause shifts in habitat use, lead to abandonment of habitat, and increase energy demands in affected wildlife (Knight and Cole 1991). Hammitt and Cole (1998) conclude that the frequent presence of humans in natural areas can dramatically change the behavior of some wildlife species.

Wildlife responses to human disturbance vary by species, and by the type, level, frequency, duration, and time of year of the human use. For example generalist species, which thrive in disturbed areas, are often more abundant along trails than specialist species that are more sensitive to human disturbance (Colorado State Parks 1998). Adverse impacts also tend to increase as user groups increase in size (Beale and Monaghan 2004).

The impact of walking along trails can have impacts even outside of the immediate trail corridor (Miller et al. 2001). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. They also found that nest predation was also greater near trails (Miller et. al 1998).

### *Indirect Effects*

When people move from one area to another, they can be vectors for the seeds or other propagules of invasive plants. Once established, invasive plants can outcompete native plants, thereby altering habitats and indirectly impacting wildlife. The threat of invasive plants establishing themselves will always be an issue that requires monitoring.

### *Cumulative Effects*

Effects that are minor when we consider them separately but may be important when we consider them collectively are cumulative effects. The principal concerns are repeated disturbances of birds that are nesting, foraging, or resting. Opening refuge land to public use can often result in litter, vandalism, or other illegal activities.

Our observations and knowledge of the areas involved provide no evidence that, cumulatively, these proposed wildlife-dependent uses will have an unacceptable effect on the wildlife resource. Although we do not expect a substantial increase in the cumulative effects of public use in the near term, it will be important for refuge staff to monitor public use and respond, if necessary, to conserve the high-quality wildlife resources on the refuge.

We expect no additional effects from wildlife observation, wildlife photography, environmental education or interpretation. Refuge staff will monitor and evaluate the effects of public use in collaboration with volunteers to discern and respond to unacceptable impacts on wildlife or habitats.

## **PUBLIC REVIEW AND COMMENT:**

As part of the comprehensive conservation planning process for Great Bay Refuge, this compatibility determination underwent extensive public review, including a comment period of 39 days that followed the release of the draft Comprehensive Conservation Plan and Environmental Assessment.

## **DETERMINATION (CHECK ONE BELOW):**

- ☐ Use is not compatible.
- ☒ Use is compatible with the following stipulations.

## **STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:**

We will monitor public use on the trail at various times of the year to assess the disturbance of wildlife. Wildlife observation, photography, environmental education, and interpretation will only be allowed on the refuge from sunrise to sunset on trails open to the public.

Groups of 10 or more people must request a special use permit from the refuge manager. Each request will then be evaluated for impacts to the refuge. Using professional judgment, as long as there is no significant negative impact to natural resources or visitor services, or violation of refuge regulations, a special use permit will be issued outlining the framework in which this use can be conducted.

## **JUSTIFICATION:**

Wildlife observation and photography, environmental education, and interpretation are priority wildlife-dependent uses, through which the public can develop an appreciation for fish and wildlife [Executive Order 12996, March 25, 1996, and the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997].

Service policy is to provide expanded opportunities for those uses when they are compatible and consistent with sound fish and wildlife management, and ensure that they receive enhanced consideration in refuge planning and management. Allowing them on the refuge will not materially interfere with or detract from the mission of the Refuge System or the purposes for which the refuge was established.

## **SIGNATURE:**

Refuge Manager: Greta W. Taylor (Signature) July 1, 2012 (Date)

## **CONCURRENCE:**

Regional Chief: Sam B. Kern (Signature) 8/17/2012 (Date)

## **MANDATORY 15 YEAR RE-EVALUATION DATE:**

8/17/2027

## **LITERATURE CITED:**

- Beale, C. M., and P. Monaghan. 2004. Human disturbance: people as predation-free predators? *Journal of Applied Ecology* 41:335-343.
- Belanger, L., and J. Bedard. 1990. Energetic cost of man-induced disturbance to staging snow geese. *Journal of Wildlife Management*. 54:36-41.
- Burger, J. 1981. Effect of human activity on birds at a coastal bay. *Biological Conservation* 21:231-241.
- Colorado State Parks. 1998. Planning trails with wildlife in mind: a handbook for trail planners prepared by Trails and Wildlife Task Force and Hellmund Associates. 51 pp. Accessed online at: <http://www.fs.fed.us/outdoors/naturewatch/start/planning/Trails-for-Wildlife-Handbk.pdf>.
- Erwin, R. M. 1980. Breeding habitat by colonially nesting water birds in 2 Mid-Atlantic U.S. regions under different regimes of human disturbance. *Biological Conservation*. 18:39-51.
- Hammit, W. E. and D.N. Cole. 1998. *Wildland Recreation*. John Wiley & Sons, New York, 361pp.
- Henson, P. T., and A. Grant. 1991. The effects of human disturbance on trumpeter swan breeding behavior. *Wildlife Society Bulletin* 19:248-257.
- Havera, S. P., L. R. Boens, M. M. Georgi, and R. T. Shealy. 1992. Human disturbance of waterfowl on Keokuk Pool, Mississippi River. *Wildlife Society Bulletin* 20:290-298.
- Kaiser, M.S. & Fritzell, E.K. 1984. Effects of river recreationists on green-backed heron behavior. *Journal of Wildlife Management* 48, 561-567.

- Kahl, R. 1991. Boating disturbance of canvasbacks during migration at Lake Poygan, Wisconsin. *Wildlife Society Bulletin* 19:242-248.
- Knight, R.L. and D. N. Cole. 1991. Effects of recreational activity on wildlife in wildlands. *Trans. 56th N.A. Wildl. & Nat. Res. Conf.* Pages 238-247.
- Korschen, C. E., L. S. George, and W. L. Green. 1985. Disturbance of diving ducks by boaters on a migrational staging area. *Wildlife Society Bulletin* 13:290-296.
- Miller, S.G., R.L. Knight, and C.K. Miller. 1998. Influence of recreational trails on breeding bird communities. *Ecological Applications* 8:162-169.
- Miller, S.G., R.L. Knight, and C.K. Miller. 2001. Wildlife responses to pedestrians and dogs. *Wildlife Society Bulletin* 29(1): 124-132.
- Morton, J. M., A. C. Fowler, and R. L. Kirkpatrick. 1989. Time and energy budgets of American black ducks in winter. *Journal of Wildlife Management* 53:401-410(also see corrigendum in *J. Wildl. Manage.* 54:683).
- Owen, M. 1973. The management of grassland areas for wintering geese. *Wildfowl*. 24:123-130.
- Ward, D. H., and R. A. Stehn. 1989. Response of brant and other geese to aircraft disturbance at Izembek Lagoon, Alaska. U.S. Fish and Wildlife Service, Alaska Fish and Wildlife Research Center. Final report to the Minerals Management Service. Anchorage, Alaska. 193 pp.
- Williams, G. J., and E. Forbes. 1980. The habitat and dietary preferences of dark-bellied brant geese and widgeon in relation to agricultural management. *Wildfowl*. 31:151-157.



## COMPATIBILITY DETERMINATION

### **USE:**

Deer Hunting

### **REFUGE NAME:**

Great Bay National Wildlife Refuge

### **ESTABLISHING AND ACQUISITION AUTHORITY(IES):**

Public Law 102-154, Section 319(d) Department of the Interior and Related Agencies Appropriations Bill, 1992.

### **REFUGE PURPOSE(S):**

Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge) was established to:

- Encourage the natural diversity of plant, fish, and wildlife species within the refuge, and to provide for their conservation and management.
- Protect species listed as endangered or threatened or identified as candidates pursuant to the Endangered Species Act of 1973.
- Preserve and enhance the water quality of aquatic habitat within the refuge.
- Fulfill the international treaty obligations of the United States relating to fish and wildlife.

### **NATIONAL WILDLIFE REFUGE SYSTEM MISSION:**

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.”—National Wildlife Refuge System Improvement Act of 1997 (Public Law 105–57; 111 Stat. 1282)

### **DESCRIPTION OF USE:**

#### **(a) What is the use? Is the use a priority public use?**

The use is white-tailed deer hunting. Hunting is a priority public use of the National Wildlife Refuge System (Refuge System) under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee), and the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

#### **(b) Where would the use be conducted?**

Firearm (shotgun) deer hunting will be allowed throughout the entire refuge excluding Fabyan Point, the enclosed area of the former Weapons Storage Area, and established safety zones.

#### **(c) When would the use be conducted?**

The firearm deer hunt will be conducted on the first weekend of the State firearm season for Wildlife Management Unit M, which includes the refuge.

**(d) How would the use be conducted?**

We will continue to conduct the use according to State and Federal regulations. Federal regulations in 50 Code of Federal Regulations pertaining to the National Wildlife Refuge System Administration Act, as well as existing, refuge-specific regulations will apply. However, the refuge manager may, upon annual review of the hunting program, impose further restrictions on hunting, recommend that the refuge be closed to hunting, or further relax hunting regulations up to the limit of State regulations. We would restrict hunting if it becomes inconsistent with other, higher priority refuge programs or endangers refuge resources or public safety.

All persons participating in the refuge hunt must hold a valid State hunting license, and then obtain a refuge hunting permit. Individuals hunting on the refuge are subject to the inspection of permits, licenses, hunting equipment, game bagged, and vehicles and their contents by Federal and State officers.

Unarmed hunters may scout the appropriate areas open to hunting the first Wednesday of November to the first Saturday of November for the firearm deer hunt. All hunters must possess the appropriate permit while scouting.

“No hunting zones” include, but may not be limited to, the fenced area of the former Weapons Storage Area, Fabyan Point property, administrative areas, and wildlife sensitive areas.

Vehicle access will only be allowed as indicated on hunt maps during the 2-day firearm deer hunt. During scouting, vehicles will park in the visitor parking lot and scout on foot.

Temporary, portable tree stands and ground blinds are acceptable and must be removed daily. Permanent trees stands and ground blinds are prohibited. Hunters cannot use screw-in steps, nails, spikes, wires, or bolts as climbing or hanging devices to attach a stand to a tree.

*Prohibited Uses*

- Using illuminating devices.
- Distributing bait, salt, or attractant, or hunting over a baited area.
- Being the under the influence, or in possession, of alcoholic beverages while hunting.
- Possessing axes, hatchets, saws, nails, tacks, paint, or flagging for the marking of trees and shrubs.
- Camping, overnight parking, open fires, dogs, or littering.

Deer may be hunted with shotguns capable of firing a single projectile (slug) during the 2-day firearm hunt in November.

A pre-season lottery will be held, with 20 permits issued per day for the 2-day firearm hunt. Selected hunters will be required to submit the required fee prior to being issued the permit.

Harvested deer must be tagged at the refuge office.

**(e) Why is this use being proposed?**

Hunting is one of the priority public uses outlined in the Refuge System Improvement Act of 1997. The Service supports and encourages priority uses when they are compatible on refuge lands. Hunting is used in some instances to manage wildlife populations, and is a traditional form of wildlife-oriented recreation that many national wildlife refuges can accommodate. The refuge hunt has been ongoing since 1996 and has been very successful and popular.

According to the New Hampshire Fish and Game Department (NHFG), deer populations in the more urban Wildlife Management Unit M, exceed the established population target for this unit. Unit M is a total of 534 square miles, of which the refuge comprises less than one-half of 1 percent. NHFG's objective for this unit is to reduce the adult male deer population by approximately 29 percent from the current 757 to 535. The refuge's hunt incrementally helps contribute to this goal. In fall 2011, 22 deer were harvested from the refuge.

## **AVAILABILITY OF RESOURCES:**

Great Bay Refuge is currently unstaffed. NHFG personnel assist the refuge with the application process by receiving and entering applications into a database, and then randomly selecting the required number of individuals and 10 alternates for each day. NHFG then provides the refuge manager with that information. Parker River Refuge staff then process all mailings and permits for selected hunters and staff Great Bay Refuge during the 2-day hunt. Due to the short timeframe of the hunt (2 weekend days) adequate staff are available from Parker River Refuge to implement the hunt at this time.

### **Anticipated costs are:**

Visitor Services Specialist (GS-12) —3 days/year= \$1,425

Deputy Refuge Manager (GS-12)—2 days/year= \$950

Biological Technician (GS-5) —2 days/year = \$300

Refuge Manager (GS-13) —5 days/year = \$2,500

Law Enforcement Officer (GS-9) (enforcement patrols) 5 days/year= \$2,000

## **ANTICIPATED IMPACTS OF THE USE:**

### *Soils and Vegetation Impacts*

The entire refuge would be open to hunters, except safety zones, Fabyan Point, and the enclosed portion of the former Weapons Storage Area. Hunters traveling off-trail may trample vegetation and introduce invasive plant propagules. The short-term impacts of trampling vegetation include damage and killing of individual plants, whereas long-term impacts include soil compaction (Kuss 1986, Roovers et al. 2004). However, due to the low number of hunters anticipated annually and the dispersed nature of hunting, we predict that these impacts will be minor. White-tailed deer foraging can also have negative impacts on native vegetation, including reduced forest regeneration and changes in plant composition and structure (Tilghman 1989, Augustine and Jordon 1998). The refuge's hunt program may contribute to reducing these vegetation impacts by reducing the local deer population.

### *Wildlife Impacts*

The use does have some disturbance to other native wildlife present on the refuge; however, keeping the deer population at a level that refuge habitat can support prevents direct impacts to other wildlife and habitat present.

### *Impacts on other Public Uses*

During the 2-day fall hunt, the refuge is closed to all public users, except permitted deer hunters. The hunt occurs during a time when few visitors are coming to the refuge for uses other than hunting. During this time of year, weather conditions also tend to reduce visitation. Also, at this time of year not much wildlife activity is occurring, therefore, there is less interest in wildlife observation and photography. Based on past seasonal visitation, we estimate that less than 100 people would be displaced during the 2-day hunt. However, it is also important to note, that many refuge visitors support hunting and would not upset by the closure.

## **PUBLIC REVIEW AND COMMENT:**

As part of the comprehensive conservation planning process for Great Bay Refuge, this compatibility determination underwent extensive public review, including a comment period of 39 days that followed the release of the draft Comprehensive Conservation Plan and Environmental Assessment.

**DETERMINATION (CHECK ONE BELOW):**

- ☐ Use is not compatible.
- ☒ Use is compatible with the following stipulations.

**STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:**

To minimize or avoid negative impacts to wildlife and habitat:

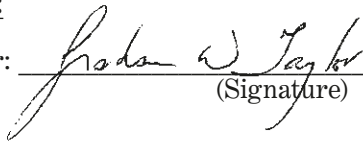
- The application process, including random selection of hunters, will be assisted by NHFG.
- Twenty permits will be available for each of the 2 days.
- Firearms will be restricted to shotgun only with a single projectile (slug).

**JUSTIFICATION:**

The Service and the Refuge System maintain goals of providing wildlife-dependent priority public uses including hunting. The white-tailed deer hunt has been conducted since 1996 and is a traditional and established program on the refuge. Annual adjustments may be made to ensure continued compatibility.

**SIGNATURE:**

Refuge Manager:

  
(Signature)

July 1, 2012  
(Date)

**CONCURRENCE:**

Regional Chief:

  
(Signature)

8/17/2012  
(Date)

**MANDATORY 15 YEAR RE-EVALUATION DATE:**

8/17/2027

**LITERATURE CITED:**

- Augustine, D.J. and P.A. Jordon. 1998. Predictors of white-tailed deer grazing intensity in fragmented deciduous forests. *Journal of Wildlife Management* 62(3): 1076-1085.
- Kuss, F. R. 1986. A review of major factors influencing plant responses to recreation impacts. *Environmental Management*, 10:638-650.
- Roovers, P., K Verheyen, M. Hermy, and H. Gulinck. 2004. Experimental trampling and vegetation recovery in some forest and heathland communities. *Applied Vegetation Science* 7:111-118.
- Tilghman, N.G. 1989. Impacts of white-tailed deer on forest regeneration in northwestern Pennsylvania. *Journal of Wildlife Management* 53:524-532.

## **COMPATIBILITY DETERMINATION**

### **USE:**

Waterfowl Hunting

### **REFUGE NAME:**

Great Bay National Wildlife Refuge

### **DATE ESTABLISHED:**

August 11, 1992

### **ESTABLISHING AND ACQUISITION AUTHORITY(IES):**

Public Law 102-154, Section 319(d) Department of the Interior and Related Agencies Appropriations Bill, 1992.

### **PURPOSE(S) FOR WHICH ESTABLISHED:**

The Great Bay National Wildlife Refuge (Great Bay Refuge) was established:

- To encourage the natural diversity of plant, fish, and wildlife species within the refuge, and to provide for their conservation and management.
- To protect species listed as endangered or threatened or identified as candidates pursuant to the Endangered Species Act of 1973.
- To preserve and enhance the water quality of aquatic habitat within the refuge.
- To fulfill the international treaty obligations of the United States relating to fish and wildlife.

### **NATIONAL WILDLIFE REFUGE SYSTEM MISSION:**

“The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.” — National Wildlife Refuge System Improvement Act of 1997 (Refuge Improvement Act) (Public Law 105–57; 111 Stat. 1282)

### **DESCRIPTION OF USE:**

#### **(a) What is the use? Is the use a priority public use?**

The use is waterfowl (geese and duck) hunting and is a priority public use of the National Wildlife Refuge System, under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997.

#### **(b) Where would the use be conducted?**

Waterfowl hunting will be allowed along the immediate tidal shoreline of Great Bay Refuge, except along the refuge shoreline of Fabyan Point. Along certain stretches of the refuge boundary, such as rocky shoreline and tidal marsh habitat, the refuge boundary signs are posted just interior of the actual refuge boundary because



the signs need to be solidly placed. The posted signs define the refuge's waterfowl hunt area. Waterfowl hunting is only allowed up to the refuge's boundary signs and hunters may not retrieve birds beyond refuge signs from the shoreline. Access for waterfowl hunting is by boat launched from off-refuge only; overland access is prohibited. Based on habitat conditions, all the refuge shoreline (e.g., tidal mudflats and rocky or forested shoreline) and observations of hunter use and distribution, most of waterfowl hunting on the refuge occurs in the tidal marsh in Herod's Cove.

**(c) When would the use be conducted?**

Waterfowl hunting will be allowed during the New Hampshire waterfowl seasons in accordance with Federal and State regulations. All hunting hours will follow New Hampshire State regulations.

**(d) How would the use be conducted?**

We will continue to conduct the use according to State and Federal regulations. Federal regulations in 50 CFR pertaining to the National Wildlife Refuge System Administration Act, as well as existing, specific refuge regulations (50 CFR § 32.48) will apply. However, the refuge manager may, upon annual review of the hunting program, impose further restrictions on hunting, recommend that the refuge be closed to hunting, or further liberalize hunting regulations up to the limits of State regulations. We will restrict hunting if it becomes inconsistent with other, higher priority refuge programs or endangers refuge resources or public safety.

All persons hunting waterfowl must hold a valid State hunting license; we do not require a separate Federal permit for waterfowl hunting. Individuals hunting on the refuge are subject to the inspection of licenses, hunting equipment, game bagged, boats, and their content by Federal and/or State officers. Hunters may only use approved nontoxic shot.

**(e) Why is the use being proposed?**

Hunting is one of the priority uses outlined in the Refuge Improvement Act of 1997. The Service supports and encourages priority uses when they are appropriate and compatible on national wildlife refuge lands. Hunting is used in some instances to manage wildlife populations. It is also a traditional form of wildlife-oriented recreation that many national wildlife refuges can accommodate. When managed appropriately, hunting can instill a unique appreciation of wildlife, their behavior, and their habitat needs.

**AVAILABILITY OF RESOURCES:**

The refuge has adequate funds to administer the waterfowl hunt program and the following breakdown shows the estimated amount of funds needed to annually manage the program:

**Annual costs to administer waterfowl hunting:**

Signs	\$100
Enforcement	\$500
<b>Total Annual Cost</b>	<b>\$600</b>

**ANTICIPATED IMPACTS:**

The following are anticipated direct, indirect, and cumulative impacts from waterfowl hunting on the refuge.

*Effects on Wildlife Species*

Waterfowl hunting and associated hunter activities (i.e., hunters boating along the shoreline, hunters retrieving waterfowl from refuge shoreline) likely will cause some minimal, short-term disturbance to target waterfowl species. Potential impacts to target waterfowl species include direct mortality or injury and indirect changes in behavior (Cline et al. 2007). Waterfowl hunting may cause waterfowl species to become more skittish and prone to disturbance (Morton 1995), reduce the amount of time that they spend feeding or resting, and may alter their habitat use (Raveling 1979, Thomas 1983, Owens 1977, White-Robinson 1982, Madsen 1985, Bartelt 1987). At Great Bay Refuge, we expect the impacts to target waterfowl species to be short-term and negligible because very few individuals (e.g., five or less persons) hunt waterfowl on the refuge annually and relatively few waterfowl are harvested each year (e.g., estimated to be less than 50 waterfowl harvested annually).

Other nontarget species that occur along the refuge shoreline may also be disturbed by the presence of waterfowl hunters who are primarily hunting from boats. Nontarget wildlife responses to recreationalists, such as hunters, can include avoidance or departure from the site (Owen 1973, Burger 1981, Kaiser and Fritzell 1984, Korschen et al. 1985, Kahl 1991, Klein 1993, Whittaker and Knight 1998), the use of sub-optimal habitat (Erwin 1980, Williams and Forbes 1980), altered behavior or habituation (Burger 1981, Korschen et al. 1985, Morton et al. 1989, Ward and Stehn 1989, Havera et al. 1992, Klein 1993, Whittaker and Knight 1998), attraction (Whittaker and Knight 1998), and an increase in energy expenditure (Morton et al. 1989, Belanger and Bedard 1990). Again, we expect these impacts to be negligible and short-term because very few individuals waterfowl hunt on the refuge each year, waterfowl hunting is limited to designated areas only, access is only by boat launched from outside of the refuge, and waterfowl hunting occurs in the fall and winter outside of the sensitive breeding season for most species.

The use of toxic shot for hunting can also cause mortality or injury to nontarget wildlife. In order to prevent these impacts, we only allow the use of nontoxic (e.g., lead-free) shot for waterfowl hunting on the refuge.

### *Effects on Vegetation and Soils*

We anticipate essentially no impacts to refuge vegetation and soils from waterfowl hunting because access is only by boat launched from outside of the refuge. Sometimes waterfowl hunters may get out of boats and come onto the refuge in front of refuge signs, mostly to retrieve birds in the tidal marsh. However, as this occurs very infrequently based on observations and only for very short amounts of time, we do not anticipate any negative impacts. In addition, hunting season occurs during the time of year when vegetation growth is slowed or dormant. In addition, the areas where waterfowl hunters may come onto the refuge shoreline is mostly rocky shoreline, where soil and vegetation is absent, or tidal marsh at low tide.

### *Effects on Water Quality and Aquatic Resources*

The use of boats, particularly motorized boats, for waterfowl hunting may cause adverse impacts on water quality and aquatic resources. Potential impacts include direct impacts, such as aquatic species mortality from waves and propeller action, and indirect impacts, including increased stress levels, increased water turbidity, loss of food sources, and the dislodging of aquatic species eggs and larvae from their substrate (Lewin et al. 2006). Motorized boats can also disturb wildlife by creating loud noises, which may interfere with hearing and release toxic inorganic and organic compounds into the water and air (Lewin et al. 2006). There is also the potential for hunters using boats to introduce aquatic invasive plants into the bay. Since so few individuals hunt on the refuge, we do not anticipate any greater than negligible, short-term impacts on water quality and aquatic resources.

### *Effects on Other Wildlife-dependent Recreational Uses*

Waterfowl hunting is a longstanding public use on the refuge. Most of the refuge is closed to hunting with the exception of waterfowl hunting along the shoreline and a limited 2-day, controlled deer hunt. Although conflicts among user groups can arise, that does not appear to be a significant issue at the present level of use. In the future, we may need to manage waterfowl hunting to minimize conflicts and insure public safety, should significant conflicts become evident. That may include public outreach or zoning to separate user groups. Conflicts between hunters have not occurred, nor is it expected due to the difficulty of hunting the refuge shoreline as well as the other waterfowl hunting opportunities throughout the bay.

### *Summary*

In summary, we anticipate that the overall direct and indirect impacts from waterfowl hunting on refuge resources will be short-term and negligible for several reasons. First, because very few visitors engage in waterfowl hunting on the refuge each year we only expect minimal amounts of disturbance to refuge wildlife from hunters. Although we do not formally track the actual numbers of hunters and their total harvest, based on staff observations, we estimate that approximately five waterfowl hunters hunt along the refuge shoreline each year. In addition, based on our estimated number of hunters and the waterfowl hunting conditions on the refuge, we expect that the total annual harvest of waterfowl on the refuge is less than 50 birds. Second, waterfowl hunting only occurs in a limited area of the refuge (only designated areas along the immediate shoreline of the refuge) and for only part of the year. The waterfowl hunting season occurs during the winter and fall, outside of the breeding season for most wildlife species. Third, we do not expect any impacts to refuge vegetation and habitats because hunting access is only permitted by boats launched from outside of the refuge and hunters only rarely come onto the refuge shoreline, mostly to retrieve downed game. Fourth, we do not expect any greater than negligible impacts on water quality because we require hunters to use nontoxic shot and remove all blinds, boats, and decoys each day. Fifth, we do not anticipate any impacts on endangered or

threatened species on the refuge because no federally threatened, endangered, or candidate species occur where waterfowl hunting is allowed. Finally, the negligible and temporary impacts of waterfowl hunting are mitigated by the presence of adjacent refuge habitat where waterfowl hunting does not occur and where birds can feed and rest undisturbed. Refuge regulations ensure that other areas of the refuge remain free of disturbance throughout the season.

We also do not anticipate any greater than negligible cumulative impacts from allowing waterfowl hunting on Great Bay Refuge. For example, we do not expect any cumulative impact on Atlantic flyway waterfowl populations. The Service manages migratory birds on a flyway basis and States establish their hunting regulations based on flyway data and the regulations framework provided by the Service. Federal and New Hampshire State regulations apply to the waterfowl hunting at Great Bay Refuge. Hunting will reduce the number of birds in the flyway, but within allowable limits as determined by State and Federal agencies.

Because the refuge has been open to hunting since it was established, and limited waterfowl hunting occurred in the area for many years before the creation of the refuge, we expect no additional impacts from continuing this use. Some negligible, short-term disturbance to non-target wildlife species may occur. However, those impacts should be minimal because waterfowl hunting occurs outside the breeding season and specific refuge regulations restrict the location and means of access.

### **PUBLIC REVIEW AND COMMENT:**

This compatibility determination underwent public review, including a comment period of 14 days.

### **DETERMINATION (CHECK ONE BELOW):**

- ☐ Use is not compatible.
- ☒ Use is compatible with the following stipulations.

### **STIPULATIONS NECESSARY TO ENSURE COMPATIBILITY:**

We will manage the hunt program in accordance with Federal and State regulations, and review it annually to ensure that wildlife and habitat management goals are achieved and that the program is providing a safe, high quality hunting experience for participants. By following Federal and State regulations and enforcing the following stipulations, we will ensure that our waterfowl hunting program is compatible with the purposes for which the refuge was established:

- Waterfowl hunters must possess a valid State waterfowl hunting permit (we do not require a separate Federal permit).
- Waterfowl hunting is only allowed up to the refuge's boundary signs and hunters may not retrieve birds beyond refuge signs on the shoreline.
- The distribution of bait or attractant, or hunting over a baited area, is prohibited.
- Hunting under the influence or possessing alcoholic beverages is prohibited.
- No commercial guiding on the refuge.
- No camping, open fires, and littering.

- No removing or altering vegetation in any way.
- No permanent structures are permitted (e.g., only temporary blinds are permitted and all decoys, blinds, and boats must be removed daily).
- No overland access for waterfowl hunting (access is by boat launched outside of the refuge only).

**JUSTIFICATION:**

Great Bay Refuge is located in on Great Bay Estuary, a coastal estuary near Portsmouth, New Hampshire. Waterfowl hunting is a traditional and well established activity in the area. It is consistent with the purposes for which the refuge was established, the Service policy on hunting, the Improvement Act of 1997, and the broad management objectives of the National Wildlife Refuge System. Waterfowl hunting is a wildlife-dependent priority public use with minimal impact on refuge resources. It does not conflict with other types of public uses that may occur on the refuge. Hunting satisfies a recreational need, but hunting on national wildlife refuges is also an important, proactive management action that can prevent overpopulation and the deterioration of habitat.

We do not expect this use to materially interfere with or detract from the mission of the Refuge System nor diminish the purposes for which the refuge was established for the following reasons. Waterfowl hunting will not detract from the refuge's purpose to conserve and manage the refuge's diversity of plant, fish, and wildlife species because very few individuals hunt waterfowl on the refuge each year and we do not allow overland access for waterfowl hunting. Waterfowl hunting will also not detract from the refuge's purpose to protect threatened and endangered species because this use will only occur in designated areas where no federally listed or candidate species occurs, and outside of breeding and nesting seasons. Finally, this use will not detract from the refuge's purpose to fulfill international fish and wildlife treaty obligations because it will occur in accordance with State and Federal regulations for waterfowl hunting which are based on Atlantic Flyway-scale population assessments and that comply with all international treaties. This use will also not cause an undue administrative burden. Annual adjustments can be made in the hunting program to ensure its continued compatibility.

**SIGNATURE:**

Refuge Manager:

Greta W. Taylor  
(Signature)

9/14/12

(Date)

**CONCURRENCE:**

Regional Chief:

Sam B. Kellum  
(Signature)

9/19/2012

(Date)

**MANDATORY 15 YEAR RE-EVALUATION DATE:**

9/19/2027

## **LITERATURE CITED:**

- Bartlet, G.A. 1987. Effects of disturbance and hunting on the behavior of Canada goose family groups in east central Wisconsin. *Journal of Wildlife Management* 51:517-522.
- Belanger, L., and J. Bedard. 1990. Energetic cost of man-induced disturbance to staging snow geese. *Journal of Wildlife Management* 54:36.
- Burger, J. 1981. Effect of human activity on birds at a coastal bay. *Biological Conservation* 21:231-241.
- Cline, R., N. Sexton, and S.C. Stewart. 2007. A human-dimensions review of human-wildlife disturbance: a literature review of impacts, frameworks, and management solutions. U.S. Geological Survey. Open-file report 2007-1111. 88 pp.
- Havera, S.P., L.R. Boens, M.M. Georgi, and R.T. Shealy. 1992. Human disturbance of waterfowl on Keokuk Pool, Mississippi River. *Wildlife Society Bulletin* 20:290-298.
- Kahl, R. 1991. Boating disturbance of canvasbacks during migration at Lake Poygan, Wisconsin. *Wildlife Society Bulletin* 19:242-248.
- Kaiser, M.S., and E.K. Fritzell. 1984. Effects of river recreationists on green-backed heron behavior. *Journal of Wildlife Management* 48:561-567.
- Klein, M.L. 1993. Waterbird behavioral responses to human disturbance. *Wildlife Society Bulletin* 21:31-39.
- Korschen, C.E., L.S. George, and W.L. Green. 1985. Disturbance of diving ducks by boaters on a migrational staging area. *Wildlife Society Bulletin* 13:290-296.
- Lewin, W-C.R. Arlinghaus, and T. Mehner. 2006. Documented and potential biological impacts of recreational fishing: insights for management and conservation. *Reviews in Fisheries Science* 14:305-367.
- Madsen, J. 1985. Impact of disturbance on field utilization of pink-footed geese in West Jutland, Denmark. *Biological Conservation* 33: 53-63.
- Morton, J.M. 1995. Management of human disturbance and its effects on waterfowl in Waterfowl habitat restoration, enhancement and management in the Atlantic Flyway (third edition). Dover, Delaware.
- Morton, J.M., A.C. Fowler, and R.L. Kirkpatrick. 1989. Time and energy budgets of American black ducks in winter. *Journal of Wildlife Management* 53:401-410.
- Owen, M. 1973. The management of grassland areas for wintering geese. *Wildfowl*. 24:123-130.
- Owens, N.W. 1977. Responses of wintering Brant geese to human disturbance. *Wildfowl* 28:5-14.
- Raveling, D.G. 1979. The annual cycle of body composition of Canada geese with special reference to control of reproduction. *Auk* 96:234-252.
- Thomas, V.G. 1983. Spring migration—The prelude to goose reproduction and a review of its implication *in* Fourth Western Hemispheric Waterfowl and Waterbird Symposium. Ottawa, Ontario. Canadian Wildlife Service. 73-81 pp.
- Ward, D.H. and R.A. Stehn. 1989. Response of Brant and other geese to aircraft disturbance at Izembek Lagoon, Alaska. U.S. Fish and Wildlife Service, Alaska Fish and Wildlife Research Center. Final report to the Minerals Management Service. Anchorage, Alaska. 193 pp.
- White-Robinson, 1982. Inland and salt marsh feeding of wintering Brent geese in Essex. *Wildfowl* 33:113-118.
- Whittaker, D., and R.L. Knight. 1998. Understanding wildlife responses to humans. *Wildlife Society Bulletin* 26:312-317.



## Appendix D

USFWS



*Lower Peverly Pond*

# Wilderness Review for Great Bay National Wildlife Refuge

- Introduction
- Phase I—Wilderness Inventory
- Summary of Wilderness Inventory Findings

## Introduction

The purpose of a wilderness review is to identify and recommend to Congress lands and waters of the National Wildlife Refuge System (Refuge System) that merit inclusion in the National Wilderness Preservation System (NWPS). Only Federal lands are eligible to be considered for wilderness designation and inclusion within the NWPS. Wilderness reviews are required elements of comprehensive conservation plans (CCPs), are conducted in accordance with the refuge planning process outlined in the U.S. Fish and Wildlife Service Manual (602 FW 1 and 3), and include compliance with the National Environmental Policy Act (NEPA) of 1969 and public involvement.

The wilderness review process has three phases:

1. Inventory Phase
2. Study Phase
3. Recommendation Phase

Lands and waters that meet the minimum criteria for wilderness are identified in the inventory phase. These areas are called wilderness study areas. During the study phase, a range of management alternatives are evaluated to determine if a wilderness study area is suitable for wilderness designation or management under an alternate set of goals and objectives that do not involve wilderness designation. Finally, the recommendation phase consists of reporting recommendations to Congress in a wilderness study report. If warranted, the wilderness study report is prepared after the record of decision for the final CCP has been signed. If any areas are recommended for designation, they would be managed to maintain wilderness character, in accordance with management goals, objectives, and strategies outlined in the final CCP, until Congress makes a decision or the CCP is amended to modify or remove the wilderness proposal.

## Phase I—Wilderness Inventory

### Introduction

The wilderness inventory takes a broad look at each planning area (wilderness inventory area) to identify wilderness study areas. A wilderness study area is an area of undeveloped Federal land that retains its primeval character and influence, without permanent improvements or human habitation, and further, meets the minimum criteria for wilderness as identified in section 2(c) of the Wilderness Act of 1964 (16 U.S.C. § 1131-1136, 78 Stat. 890; Public Law 88-577).

### Minimum Wilderness Criteria

A wilderness study area is required to:

- Appear *natura*.
- Provide for *solitude or primitive recreation*.
- Be either a *roadless* area that meets the *size* criteria or an island of any size.

The following section provides a more detailed description of the four minimum wilderness criteria: naturalness, solitude or primitive and unconfined recreation, roadless, and size.

### Naturalness

The Wilderness Act, section 2(c), defines wilderness as an area that “generally appears to have been affected primarily by the forces of nature with the imprint of human work substantially unnoticeable.” The area must appear natural to the average visitor, rather than “pristine.” The presence of historic landscape conditions is not required.

An area may include some human impacts provided they are substantially unnoticeable in the unit as a whole. Significant hazards caused by humans, such as the presence of unexploded ordnance from military activity and the physical impacts of refuge management facilities and activities are also considered in evaluating the naturalness criteria.

An area may not be considered unnatural in appearance solely on the basis of the sights and sounds of human impacts and activities outside the boundary of the unit. The cumulative effects of these factors in conjunction with land base size, and physiographic and vegetative characteristics were considered in the evaluation of naturalness. The following factors were the primary considerations in evaluating naturalness:

- A. The area appears to have been affected primarily by the forces of nature with the imprint of human work substantially unnoticeable.
- B. The area may include some human impacts provided they are substantially unnoticeable in the unit as a whole.
- C. Does the area contain significant hazards caused by humans, such as the presence of unexploded ordnance from military activity?
- D. The presence of physical impacts of refuge management facilities and activities.

### **Solitude or Primitive and Unconfined Recreation**

A wilderness study area must provide outstanding opportunities for solitude or primitive and unconfined recreation. The area does not have to possess outstanding opportunities for both solitude and primitive and unconfined recreation, and does not need to have outstanding opportunities on every acre. Further, an area does not have to be open to public use and access to qualify under this criteria; Congress has designated a number of wilderness areas in the Refuge System that are closed to public access to protect resource values.

Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport. These primitive recreation activities may provide opportunities to experience challenge and risk, self reliance, and adventure. Solitude and primitive unconfined recreation are not well defined by the Wilderness Act, but can be expected to occur together in most cases. However, an outstanding opportunity for solitude may be present in an area offering only limited primitive recreation potential. Conversely, an area may be so attractive for recreation use that experiencing solitude is not an option.

The following factors were the primary considerations in evaluating outstanding opportunities for solitude or primitive unconfined recreation:

- A. The area offers the opportunity to avoid sights, sounds, and evidence of other people. A visitor to the area should be able to feel alone or isolated.
- B. The area offers non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport.

### **Roadless**

Roadless refers to the absence of improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use. A route maintained solely by the passage of vehicles does not constitute a road.

The following factors were the primary considerations in evaluating the roadless criteria:

- A. The area does not contain improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use.
- B. The area is an island, or contains an island, that does not have improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use.
- C. The area is in Federal fee title ownership.

### **Size**

The size criteria can be satisfied if an area has at least 5,000 acres of contiguous roadless public land, or is sufficiently large that its preservation and use in an unimpaired condition is practicable.

The following factors were the primary considerations in evaluating the size criteria:

- A. An area of more than 5,000 contiguous acres. State and private lands are not included in making this acreage determination.
- B. A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or that is markedly distinguished from the surrounding lands by topographical or ecological features.
- C. An area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.
- D. An area of less than 5,000 contiguous acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency such as the U.S. Department of Agriculture - Forest Service, National Park Service, or Bureau of Land Management.

### Supplemental Values

The Wilderness Act states that an area of wilderness may contain ecological, geological, or other features of scientific, educational, scenic, or historical value. Supplemental values of the area are optional, but the degree to which their presence enhances the area's suitability for wilderness designation should be considered. The evaluation should be based on an assessment of the estimated abundance or importance of each of the features.

### Great Bay National Wildlife Refuge

The CCP planning team identified the entirety of Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge) (map D.1) as the only wilderness inventory area because there are no natural terrain barriers separating any portion of the refuge from any other portion. The CCP Planning Team evaluated the refuge to determine if it retains a primeval character and influence, is without permanent improvements or human habitation, and further, meets the minimum criteria for wilderness as identified in section 2(c) of the Wilderness Act. Our findings are described below.

Does the wilderness inventory area meet the following criteria:

- (1) *Have at least 5,000 acres of land, or is it of sufficient size to make practicable its preservation and use in an unconfined condition, or is it a roadless island?*

No. The refuge is only 1,103 acres in size and is not a roadless island. It is also not of sufficient size to preserve and use in an “unconfined” or “unimpaired” condition due to its land use history as an Air Force Base. Remnants of the Pease Air Force Base are still visible on the refuge, including the former Weapons Storage Area with concrete bunkers. Adjacent to the refuge is the remainder of the former Air Force Base which has been converted into the Pease International Tradeport. The tradeport is heavily developed and houses an international airport, office and industrial space, restaurants, and hotels.

- (2) *Generally appear to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable?*

No. The majority of the refuge would not look natural to the average visitor because of substantially noticeable human impacts.

The refuge has several administrative buildings, including refuge headquarters, refuge housing, and a maintenance building. Adjacent to refuge headquarters is a visitor parking lot, interpretive kiosk, and public restrooms. There are several service roads throughout the refuge. Two hiking trails begin at the visitor parking lot. The Ferry Way Trail begins as an asphalt path and then follows several old woods roads. The Peverly Pond Trail is paved with crushed stone and is Americans with Disabilities Act (ADA)-accessible. This trail leads to a wildlife blind and viewing platform. The refuge also has several man-made impoundments, including three on Peverly Brook and two other smaller impoundments along trails.

In addition to these facilities, the refuge also has two historic buildings listed on the National Registry of Historic Places: the Margeson-Hawkridge-Loomis Estate and caretaker's residence. As noted above, remnants of the former Pease Air Force Base are visible in several locations on the refuge, including the former Weapons Storage Area. This area is currently fenced in with by a chain-linked fence and concrete bunkers are visible. Again, the refuge is adjacent to an international airport that can be heard throughout the refuge.



Map D.1. Great Bay National Wildlife Refuge





*(3a) Have outstanding opportunities for solitude?*

No. There are few opportunities for visitors to be alone and feel secluded from other visitors in the area. Unnatural noise from the Pease International Tradeport detracts from solitude, as do the presence of refuge facilities and the former Weapons Storage Area.

Large portions of the refuge are closed to the public, including the former Weapons Storage Area. Most visitors are confined to two popular nature trails which limit opportunities to feel alone on the refuge. Although hunters have access to a greater portion of the refuge during a 2-day white-tailed deer hunt, the hunt is highly regulated and is only allowed in designated areas. Waterfowl hunting is also permitted along the refuge shoreline, but access is via boat only and not by foot through the refuge.

*(3b) Have outstanding opportunities for a primitive and unconfined type of recreation?*

No. The refuge does not have outstanding opportunities for primitive or unconfined recreational use. As mentioned above, major portions of the refuge are closed to most visitors limiting opportunities for unconfined and primitive recreation. Most recreation is limited to popular nature trails. Off-trail and off-road access is prohibited, except to white-tailed deer hunters during the 2-day hunt. Although these hunters have a somewhat greater opportunity for dispersed recreation, the hunt is highly regulated and only occurs in designated areas.

Also, noise from the Pease International Tradeport can be heard throughout the refuge. Although the Tradeport is outside of the wilderness study area, its noise has a major impact and would also likely diminish opportunities for a primitive experience.

*(4) Contain ecological, geological, or other features of scientific, educational, scenic, or historical value?*

Yes. The refuge contains a variety of features of ecological value. The refuge has a diversity of habitat types, from forested uplands, shrublands and grasslands, freshwater wetlands, and rocky shoreline. The refuge also supports five exemplary natural communities, as identified by the New Hampshire Natural Heritage Bureau, including high salt marsh, coastal rocky headland, black gum-red maple basin swamp, and dry and mesic Appalachian oak-hickory forest. The refuge is home to a variety of animal species, while the larger Great Bay Estuary supports habitat for 23 species of federally and State-listed threatened and endangered plants and animals.

In addition, the refuge has an array of historical and cultural resources. At least 22 archaeological or historical sites are identified on the refuge. The refuge has two buildings on the National Registry of Historic Places: the Margeson-Hawkridge-Loomis Estate and its caretaker's residence. As part of the former Pease Air Force Base, the refuge also contains historical remnants of the base, including a former Weapons Storage Area.

## **Summary of Wilderness Inventory Findings**

The CCP Planning Team found that Great Bay Refuge does not meet any of the minimum criteria for wilderness as identified in section 2(c) of the Wilderness Act. While there are ecological and historic values on the refuge, these do not, in and of themselves, warrant wilderness recommendation. In summary, Great Bay Refuge does not qualify as a wilderness study area, and will not be considered further for wilderness designation in this CCP.

## Appendix E

USFWS



*Water tower in the former Weapons Storage Area*

## **Refuge Operation Needs System (RONS) and Service Asset Maintenance Management System (SAMMS) Projects**

## Refuge Operation Needs System and Service Asset Maintenance Management System

Great Bay National Wildlife Refuge's (Great Bay Refuge, the refuge) budget requests contained in the Refuge Operating Needs System (RONS) and Service Asset and Maintenance Management System (SAMMS) databases include a wide variety of new projects and maintenance needs. The RONS and SAMMS lists are regularly updated to include priority projects. Contact the refuge for the most current RONS and SAMMS lists.

**Table E.1. Current Projects in the RONS Database for Great Bay Refuge**

Station Priority Rank	Project Description	Estimated One-time cost	Recurring Base Cost	Total First Year Need	FTE <sup>†</sup>
1	Complete and implement Comprehensive Conservation Plan	–	\$128,986	\$128,986	1.0
2	Provide assistance to area partnerships to manage over 10,000 acres	\$32,500	\$14,500	\$47,000	–
3	Use prescribed fires to manage and maintain habitat for federally listed and State-listed species	\$25,000	\$7,500	\$32,500	–
4	Maintain and manage refuge facilities and equipment for managing natural resources and providing visitor services	–	\$72,371	\$72,371	1.0
5	Monitor and manage refuge habitat to provide biological diversity and environmental health	–	\$128,986	\$128,986	1.0
6	Provide and enhance recreational and educational opportunities to residents and visitors about the refuge, conservation, and area environmental issues	–	\$106,614	\$106,614	1.0
7	Manage and restore 400 acres of early successional, marine, and freshwater habitats for rare, threatened, and endangered species, anadromous fish and other aquatic species	\$38,500	\$29,500	\$116,423	–
8	Provide and enhance priority public use opportunities and engage youth	\$40,000	\$23,000	\$99,317	–
9	Monitor biological diversity and management actions on 1,100 acres to evaluate achievement of biological goals and objectives as outlined in approved management plans	\$35,000	\$25,000	\$60,000	–
<b>Totals</b>		<b>\$171,000</b>	<b>\$536,457</b>	<b>\$792,197</b>	<b>4.0</b>

<sup>†</sup> FTE= Full-time equivalent (i.e., full-time staff position)

Table E.2. Projects Proposed for the RONS Database for Great Bay Refuge under this CCP

Station Priority Rank*	Project Description	Estimated One-time cost	Recurring Base Cost	Total First Year Need
1	Restore and manage 20 acres of former Weapons Storage Area as predator-free habitat for New England Cottontail rabbit and declining bird species dependent on shrub habitat	\$150,000	\$45,000	\$180,000
2	Remove Lower Peverly Dike and Control Structure, restore 1,000 feet of free-flowing stream, and monitor environmental conditions and habitat pre- and post-restoration (costs related to planning and monitoring)	\$200,000	\$20,000	\$220,000
3	Research, monitor, and manage six bat species and associated habitats and convert former military bunkers into hibernacula	\$40,000	\$30,000	\$70,000
4	Monitor water quality and sediments within the Peverly Brook Drainage on the refuge to track contamination levels from the former Pease Air Force Base and current uses adjacent to the refuge	\$75,000	\$35,000	\$110,000
5	Partner with New Hampshire Fish and Game to restore and manage pine barrens habitat for the federally endangered Karner blue butterfly, and to increase the population through a captive rearing program	\$60,000	\$15,000	\$75,000
6	Establish monitoring sites with partners to track habitat changes due to sea level rise and climate change using Sediment Elevation Tables (SET) in salt marshes and phenological changes in other habitats following standard protocols used by multiple agencies	\$50,000	\$25,000	\$75,000
7	Eradicate, control, and monitor multiple invasive plant species within the refuge to improve habitat conditions for listed, candidate, and declining species that are present or could be restored	\$30,000	\$45,000	\$75,000
8	Research, monitor, and restore aquatic habitats and resources with emphasis on eelgrass, oysters, and horseshoe crabs within 400 acres of marine and estuarine habitats. Work with Great Bay area partners to support and coordinate actions using standard practices and techniques.	\$250,000	\$50,000	\$50,000
<b>Totals</b>		<b>\$855,000</b>	<b>\$265,000</b>	<b>\$855,000</b>

Table E.3. Current Projects in the SAMMS Database for Great Bay Refuge

Project Number	Project Description	Estimated Cost
01110818	Rehabilitate at the Weapons Storage Area	\$195,000
01110820	Remove communication building #420	\$32,000
01110826	Remove military water storage tank	\$96,000
03126013	Rehabilitate water supply building	\$39,000
03126354	Replace and remove building #436	\$114,000
03126355	Remove building #437	\$183,600
03126356	Remove and replace building #465	\$11,000
03126357	Remove and replace building #466 with solar	\$503,900
03126358	Remove building #468	\$168,100
04133936	Remove cabin at 150 Fabyan Point Road	\$14,200
04133945	Remove old stone house at Fabyan Point	\$55,700
05038515	Remove cabin at 154 Fabyan Point Road	\$21,300
05038517	Remove cabin at 158 Fabyan Point Road	\$16,300
05038520	Remove cabin at 162 Fabyan Point Road	\$16,300
05138522	Remove cabin at 166 Fabyan Point Road	\$21,300
05138532	Remove house at 138 Fabyan Point Road	\$43,800
05138593	Remove storage shed formerly used as hanger	\$10,000
2005207406	Rehabilitate service road	\$515,000
2005207464	Remove and replace deteriorated building	\$168,100
2005256059	Remove caretaker residence	\$26,000
2005256102	Rehabilitate Karner Blue Easement trailhead contact point	\$47,000
2005256237	Replace fencing at Karner Blue Butterfly	\$327,000
2006506630	Replace electronic gate controller and gate	\$33,000
2008865067	Replace service road culverts to Stubbs Pond	\$30,000
2008865068	Replace Upper Peverly Pond water control structure	\$197,000
2008865094	Removing Lower Peverly Dam by breaching Dam (costs related to removing structure)	\$500,000
2008869147	Rehabilitate service and access road	\$750,000
2008869148	Rehabilitate entrance road	\$365,800
2008869149	Rehabilitate public parking lot	\$103,900
2008869151	Replace Loomis well pump	\$30,000
2008869182	Remove rescue team facility	\$36,000
2008869184	Remove electrical substation #480	\$28,000
2008869185	Remove electrical substation #481	\$28,000
2008869187	Remove electrical substation #482	\$28,000
2008869189	Remove electrical substation #483	\$28,000
2008869191	Remove electrical substation #484	\$28,000



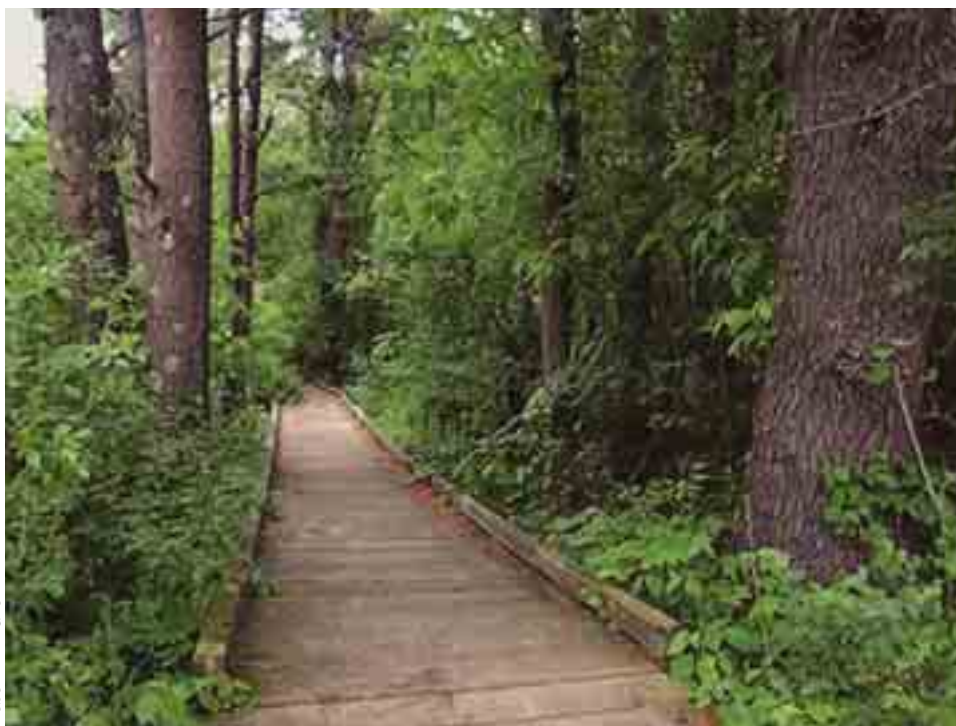
Project Number	Project Description	Estimated Cost
2008869193	Remove electrical substation #485	\$28,000
2008869195	Remove electrical substation #486	\$28,000
2008869197	Remove electrical substation #487	\$28,000
2008869200	Remove electrical substation #488	\$28,000
2010137228	Rehabilitating Margeson Estate Main House	\$100,000
2010129650	Repair and Rehabilitate Stubbs Pond Dam	\$36,650
2010129771	Repair Stubbs Pond Fish Ladder	\$6,000
2010129772	Repair Stubbs Pond WCS	\$10,000
2010131080	Repair Upper Peverly Dam	\$23,125
2011178789	Repairs to refuge residence	\$10,000
2011178791	Repair and replace sections Peverly Trail	\$10,000
01110822	Remove Military Storage Igloo	\$36,000
01110823	Remove Military Storage Igloo	\$36,000
2008869156	Remove Military Storage Igloo	\$36,000
2008869158	Remove Military Storage Igloo	\$36,000
2008869160	Remove Military Storage Igloo	\$36,000
2008869162	Remove Military Storage Igloo	\$36,000
2008869164	Remove Military Storage Igloo	\$36,000
2008869166	Remove Military Storage Igloo	\$36,000
2008869168	Remove Military Storage Igloo	\$36,000
2008869170	Remove Military Storage Igloo	\$36,000
2008869172	Remove Military Storage Igloo	\$36,000
2008869174	Remove Military Storage Igloo	\$36,000
2008869176	Remove Military Storage Igloo	\$36,000
2008869178	Remove Military Storage Igloo	\$36,000
2008869180	Remove Military Storage Igloo	\$36,000
<b>Total Costs</b>		<b>\$5,658,075</b>

**Table E.4. Proposed Projects for the SAMMS Database for Great Bay Refuge under this CCP**

<b>Project Description</b>	<b>Estimated Cost</b>
Create an RV Site with two hookups for seasonal volunteers	\$15,000
Remove Margeson Estate	\$75,000
Construct medium-size Office and Visitor Contact Station	\$3,500,000
Construct maintenance/storage facility	\$1,000,000
Construct ferry Way Trail Overlook	\$5,000
Remove the WSA Water Control Structure	\$5,000
Replace the fence surrounding the former WSA	\$200,000
Create new access road to the south end of the WSA	\$30,000
Replace refuge signs	\$25,000
Replace Peverly Pond blind	\$15,000
Construct information kiosk at Karner Blue Easement	\$10,000
Install photovoltaic panels for existing modular office	\$40,000
Install photovoltaic panels for existing modular residence	\$25,000
<b>Total Costs</b>	<b>\$4,945,000</b>

## Appendix F

Rebecca McGrew



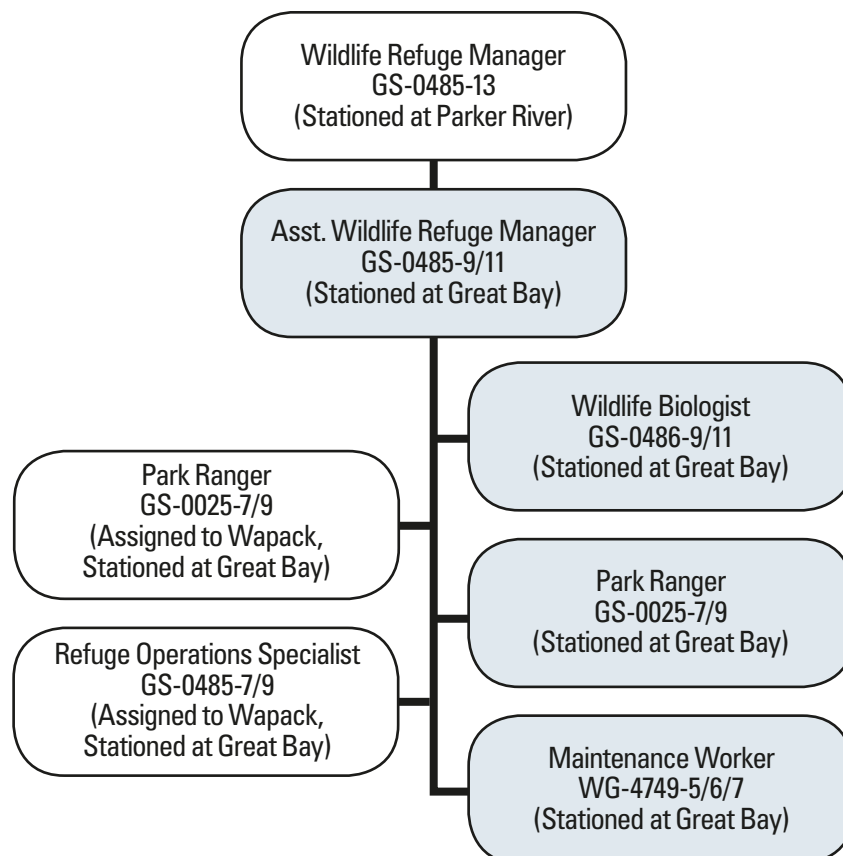
*Boardwalk on Ferry Way Trail*

## Staffing Chart

**U.S. Fish and Wildlife Service  
Northeast Region  
Regional Chief, National Wildlife Refuge System  
Great Bay National Wildlife Refuge**

**Proposed Staffing for Great Bay National Wildlife Refuge**

Staff listed on this chart will also help administer Wapack National Wildlife Refuge and the Karner blue butterfly conservation easement. Two of the positions listed below will be assigned to Wapack National Wildlife Refuge, but be stationed at Great Bay National Wildlife Refuge. The Refuge Manager at Parker River National Wildlife Refuge will oversee all staff stationed at Great Bay National Wildlife Refuge.



## Appendix G

Mao Teng Lin/USFWS



*The Margeson Estate main house at Great Bay National Wildlife Refuge*

## **Compliance with Section 7 of the Endangered Species Act, Section 106 of the National Historic Preservation Act, and the Coastal Zone Management Act**



## INTRA-SERVICE SECTION 7 BIOLOGICAL EVALUATION FORM

**Originating Person:** Graham Taylor

**Telephone Number:** 978-465-5753, extension 201

**Date:** July 17, 2012

**I. Service Program and Proposed Activity** – NWRs, Great Bay National Wildlife Refuge (NWR), and Karner Blue Butterfly Easement; implementation of Comprehensive Conservation Plan (CCP).

### II. Pertinent Species Within the Area

Karner blue butterfly (*Lycaedes melissa samuelis*) endangered  
New England cottontail (*Sylvilagus transitionalis*) candidate

### III. Station Name and Action

Great Bay NWR and Karner Blue Butterfly Conservation Easement – Implementation of final CCP.

Alternative B (CCP Preferred Alternative): emphasize the management of specific refuge habitats to support focal species whose habitat needs benefit other species of conservation concern that are found in the Great Bay region.

### IV. Location

Great Bay NWR, Rockingham County, Newington, NH, and Karner Blue Easement, Merrimack County, Concord, NH

### V. Determination of Effects

#### A. Explanation of effects of action on species and critical habitats listed in II

The Management Implementation and Direction chapter of the Final CCP includes specific objectives and strategies under Goal 5 for the Karner blue butterfly. Objective 2.3 (Upland Habitats) includes specific strategies for the New England cottontail. The CCP also considers using a portion of the Refuge as a captive-rearing site for the New England cottontail. For both of these species, the goals, objectives, and strategies have been developed to enable the Refuge to support efforts for the recovery of both species; thus having a positive and beneficial effect for both.

**Karner blue butterfly** - The Karner Blue Butterfly Recovery Plan (Recovery Plan), dated September 2003, provides a summary of the species' life history and is incorporated by reference. In summary, the only known food plant for the Karner blue butterfly is the wild blue lupine (*Lupinus perennis*), which typically occupies sandplain communities and grassy openings within very dry, pitch pine/scrub oak barrens. Fire is an important disturbance element for this habitat type that is needed to maintain the conditions that allow the lupine to persist. As a result of fire suppression throughout the Karner blue butterfly's range, habitat value has declined and some areas have degraded to the point that they no longer provide suitable habitat.

Habitat management for the Karner blue butterfly involves the implementation of prescribed fire and other vegetation management techniques (i.e., tree clearing and brush cutting) to create conditions that will allow wild lupine to persist. Because Karner blue butterfly eggs, larvae, pupae, and adults can be found on and near lupine during all times of the year, the use of prescribed fire and other habitat management techniques will result in the taking (harm or kill) of individual butterflies, while providing benefits to the population.

Continuation of public use of the Karner blue butterfly easement will also occur, primarily as foot traffic along existing trails and access ways. There is no evidence that this public use is having an adverse effect on the species at this site.

**New England cottontail** - Although not required by law, including candidate species is U.S. Fish and Wildlife Service (Service) policy when making natural resource decisions during internal Service conferencing to ensure that the Service action does not jeopardize the species.

**New England Cottontail Controlled Propagation** - Controlled propagation is currently being employed as a conservation measure to help recover the New England cottontail in the southern portion of the species range. Expansion of this effort into the northern portion of the species' range has been recommended as a way to establish new populations, or augment existing populations (see the current draft of the *Conservation Strategy for the New England Cottontail*, dated June 2012). To facilitate these efforts in the New Hampshire and Maine portions of the species' range, the Great Bay NWR is proposing to devote a portion of the Refuge as a captive-rearing site. As a result, a jeopardy analysis is needed.



In accordance with policy and regulation, a jeopardy analysis relies on four components: (1) the *Status of the Species*, which evaluates the condition of the species rangewide, the threats to the species and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated activities on the species; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the species.

Although the captive propagation of the New England cottontail is intended to complement the recovery of the species, a complete jeopardy analysis that includes conservation recommendations for ensuring the well-being of individual rabbits that are produced or maintained for this effort is needed. In addition to the need for internal conferencing on Service actions, compliance with the Service's *Controlled Propagation Policy* is also required (65 FR 56916), which will be completed upon finalization of a document describing husbandry and reintroduction procedures for the New England cottontail. Production of this document is currently underway by the New England cottontail Captive Breeding Working Group that includes individuals with expertise in veterinary care, animal husbandry, captive breeding for conservation, and taxonomic experts familiar with the biology of the species.

**New England Cottontail Habitat Management** – There are no known occurrences of the New England cottontail on the Great Bay NWR; therefore, implementation of habitat management on the Refuge will have no effect on the species. In the event that the New England cottontail disperses to, or is introduced to the Refuge, internal conferencing will be required and initiated by Great Bay NWR staff.

#### **B. Explanations of actions to be implemented to reduce adverse effects.**

**Karner blue butterfly** - At the Karner blue butterfly easement, Great Bay NWR staff proposes the continuation of habitat management activities that will maintain the habitat and enhance the long-term viability of the Karner blue butterfly population, but these activities may result in the take (death or injury) of individuals. Actions to avoid take may include timing management activities to avoid impacts to adults, and pre-activity surveys for eggs, larvae and pupae, and relocating those that may be impacted. However, the eggs, larvae and pupae of the Karner blue butterfly are difficult to find because they are extremely small and easily hidden by leaf litter; accordingly, we expect that surveys will be unable to find all Karner blue butterflies that are present in the various life stages. As a result of the take of Karner blue butterflies resulting from the implementation of recovery actions, Great Bay NWR will apply for a Section 10(a)(1)(A) Enhancement of Survival Permit.

**New England Cottontail Controlled Propagation** - A document describing propagation and reintroduction protocols for the New England cottontail is currently being developed by the New England cottontail Captive Breeding Working Group. These protocols will include recommendations to ensure the well being of individual rabbits that are confined or produced for release into the wild.

**New England Cottontail Habitat Management** – Because the New England cottontail is not known to occur at the Great Bay NWR, adverse effects are not anticipated.

## **VI. Effect Determination and Response Requested**

### **A. Listed Species Determination**

**Karner blue butterfly** – Management actions are expected to have a beneficial effect on the Karner blue butterfly population; however, implementation of the habitat management actions is likely to adversely affect the species because the actions are expected to result in take of Karner blue butterflies. To address this take, Great Bay NWR will apply for a Section 10 (A)(1)(a) Enhancement of Survival Permit. Formal consultation, in association with the issuance of the recovery permit will address those actions taking place on the Karner blue butterfly easement.

**New England Cottontail Controlled Propagation** - Because the controlled propagation of the New England cottontail is being proposed in support of recovery actions for the species, the controlled propagation of the species at the Great Bay NWR is not expected to jeopardize the continued existence of the species. However, a complete jeopardy analysis will be conducted upon completion of a document describing husbandry and reintroduction protocols for the New England cottontail that are expected to be completed by January 2013.

**New England Cottontail Habitat Management** – Is not likely to adversely affect.

### **B. Response Requested**

Concurrence

**VII. Reviewing Ecological Services Office Evaluation**

**A. Concurrence**

**B. Formal Consultation Required**

**C. Conference Required**

**D. Nonconcurrence**

Remarks:



Thomas R. Chapman, Supervisor  
New England Field Office

20 July 2012  
Date





April 3, 2012

Nancy L. McGarigal  
NWRS Planning Team Leader, Region 5  
300 Westgate Center Drive  
Hadley, MA 01035

Re: Request for comment on the Draft Comprehensive Conservation Plan  
and Environmental Assessment (CCP/EA) for the Great Bay Wildlife  
Refuge in Newington, NH.

Dear Ms. McGarigal:

The NH Division of Historical Resources (Division) appreciates the  
invitation to comment on the Draft Comprehensive Conservation Plan and  
Environmental Assessment (CCP/EA) for the Great Bay Wildlife Refuge in  
Newington, NH.

The information presented in the Draft CCP/EA for the Great Bay  
Wildlife Refuge is considered thorough and comprehensive.

Within the Great Bay Wildlife Refuge many areas are considered  
archaeologically sensitive with regard to Native American site  
potential and early historic site potential. The Division would be  
concerned with areas proposed for wildlife management and proposed  
projects for the public use program with regard to trail enhancements  
or other ground disturbing activities.

The Division requests that as this planning process continues  
identified cultural resources and areas considered sensitive are taken  
into consideration. The Division understands that those activities may  
directly or indirectly affect the historical resources located within  
the Great Bay Wildlife Refuge. Please continue to provide the Division  
an opportunity to comment as plans develop.

Sincerely,

Richard Boisvert, State Archaeologist  
Deputy SHPO, Division of Historical Resources

RAB/emf





The State of New Hampshire  
**Department of Environmental Services**

**Thomas S. Burack, Commissioner**

*Celebrating 25 Years of Protecting  
New Hampshire's Environment*



April 16, 2012

Graham Taylor  
Refuge Manager  
c/o Parker River National Wildlife Refuge  
6 Plum Island Turnpike  
Newburyport, MA 01950

RE: File No. 2012-04; Great Bay National Wildlife Refuge Draft Comprehensive  
Conservation Plan

Dear Mr. Taylor:

The New Hampshire Coastal Program has received the U.S. Fish and Wildlife Service's federal consistency determination for the Great Bay National Wildlife Refuge Draft Comprehensive Conservation Plan (CCP), pursuant to Section 307(c)(1) of the Coastal Zone Management Act, 16 U.S.C. § 1456(c)(1). After reviewing the Draft CCP, we find it to be consistent, to the maximum extent practicable, with the enforceable policies of New Hampshire's federally approved coastal management program.

Should you have any questions, please feel free to contact me at (603) 559-0025.

Sincerely,

A handwritten signature in black ink that reads "Christian Williams".

Christian Williams  
Federal Consistency Coordinator  
New Hampshire Coastal Program

cc: Nancy McGarigal, USFWS  
Doug Grout, NH Fish & Game Dept.

[www.des.nh.gov](http://www.des.nh.gov)

29 Hazen Drive • PO Box 95 • Concord, NH 03302-0095  
(603) 271-3503 • TDD Access: Relay NH 1-800-735-2964

## Appendix H

USFWS



*Herods Cove shoreline looking north*

# Forest Health Assessment for Great Bay National Wildlife Refuge



## **Forest Health Assessment Great Bay National Wildlife Refuge**

US Forest Service  
Forest Health Protection  
Durham Field Office



Kevin J. Dodds  
Forest Entomologist  
603-868-7743  
kdodds@fs.fed.us

Robert Cooke  
Forester  
603-868-7705  
rcooke@fs.fed.us



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## Introduction

An assessment of the health of forested land at Great Bay National Wildlife Refuge was requested by the U.S. Fish and Wildlife Service in 2006. This assessment is being conducted by the USDA Forest Service, Durham Field Office, Forest Health Protection staff. The survey design was implemented during the summer/fall of 2006 and is summarized in this report.

Forest health assessments provide a general overview of the conditions of forested areas and can be used to guide forest management decisions and/or inform natural resource managers about potential health concerns in forests under their stewardship. Assessments consider the “health” of overstory trees (e.g., crown condition, growth form etc.), regeneration in stands, presence/absence of native insects at damaging levels, and presence of exotic or invasive species that could threaten the integrity of native ecosystems. Forest health assessments also provide a means for comparing the condition of targeted forest stands to regional growth patterns found in other forest stands.

The Great Bay National Wildlife Refuge, established in 1992, is a 1,100+ acre refuge located on the former Pease Air Force Base in Newington, NH. The refuge was established to encourage the natural diversity of plant, fish and wildlife species within the refuge and to provide for their conservation and management; to protect species listed as endangered, threatened or candidate species; to preserve and enhance water quality of aquatic habitat within the refuge; and to fulfill international treaty obligations of the United States relating to fish and wildlife. The refuge contains a diverse set of ecosystem types including tidal, wetlands, and forests. Forests make up approximately 70% (763 acres) of the land area and have been classified into ten separate natural community types. These forested areas are the focus of this forest health assessment.

## Methods

### Inventory Design

*Plot Design:* Temporary variable radius plots (BAF 10) were placed on transects throughout the forested areas of GBNWR during the summer and fall 2006. Within each plot, tree measurements (species, diameter at breast height, crown class, stocking level), estimates of tree health, and snag density were recorded. Snags were placed into one of three decay classes. Visual inspections for native and invasive insect species were conducted. Signs or symptoms of bark beetles (Coleoptera: Scolytinae), woodborers (Coleoptera: Cerambycidae, Buprestidae; Hymenoptera: Siricidae), and late season defoliators on trees were recorded. Visual surveys for invasive species including hemlock woolly adelgid (*Adelges tsugae* Annand), Asian longhorned beetle (*Anoplophora glabripennis* Motschulsky), emerald ash borer (*Agrilus planipennis* Fairmaire), and *Sirex noctilio* F. were conducted. Inspections for native and invasive tree pathogens were also completed.

**Inventory Stratification:** A Natural Communities map created by the New Hampshire Natural Heritage Bureau (Sperduto 2000) was used to stratify the inventory. These natural communities are recurring assemblages of plants found in particular physical environments (Sperduto et al. 2004). Each natural community is distinguished by three characteristics: 1) a definite plant species composition; 2) a consistent physical structure (such as forest, shrubland, or grassland); and 3) a specific set of physical conditions (such as different combinations of nutrients, drainage, and climate conditions). The New Hampshire Natural Heritage inventory identified 763 acres of forest, divided into 10 natural communities (Figure 1). The 10 natural communities identified were:

- 1) Black gum-red maple basin swamp (not sampled)
- 2) Dry Appalachian oak-hickory forest
- 3) Dry-mesic Appalachian oak-hickory forest
- 4) Forest on fill
- 5) Low red maple-elm/musclewood/ladyfern silt forest
- 6) Mesic Appalachian oak-hickory forest
- 7) Plantation
- 8) Red maple/sensitive fern-tussock sedge basin/seepage (not sampled)
- 9) Red pine forest/woodland
- 10) Seasonally saturated red maple swamp

The assessment consisted of a stratified random sample, utilizing variable radius plots as detailed above. This portion of the assessment was implemented to characterize the forested vegetation, including species and size class distribution, stocking, and volume estimates in the natural communities and to familiarize the authors with Refuge lands. While not all stands were inventoried, we attempted to stratify the sample so that examples of each of the natural communities were represented. The black gum-red maple basin swamp and the red maple/sensitive fern/tussock sedge basin/seepage natural communities were not inventoried due to excessive water levels.

Variables collected on the inventory points:

#### **Species**

#### **Diameter at breast height**

**Timber Product Quality Assessment:** Common forest health and general forestry metrics. They are used to gauge the overall quality of the site and growth potential. The amount and quality of the wood products are measures of productivity of the site. They also give insights to the current composition, as well as vertical structure potential.

- Timber quality - A determination if the tallied tree will produce a sawtimber product. AGS means Acceptable Growing Stock for timber - capable of producing sawtimber when it reaches appropriate size, and expected to live at least 15 years; UGS = Unacceptable Growing Stock for timber - not capable of producing sawtimber at any time in future and/or not expected to survive for 15 years.
- Product - An estimate of the highest value product or grade obtained in the tree.
- Sawlog height - The total height of sawtimber products in the tree in feet.



- **Pulp height** - The portion of the tree above sawtimber height, or if the tree does not contain any sawtimber, the merchantable pulpwood height.

**Cavity** - Cavity present in main stem or large branches.

- **Live/Dead** - condition of tree where cavity was found.
- **Tree species** - tree species if identifiable. Grouped as conifer or hardwood for analysis.

**Crown class** - The position of the tree crown using these classifications:

- **Open grown** - a tree that is free of competition and receives light on top and on all sides of the crown as a result of a very heavy thinning or being in an isolated, open-grown position.
- **Dominant** - a tree with the crown extending above the general level of the main crown canopy and receiving full light from above and partly from the sides.
- **Codominant** - a tree with a crown forming the general level of the main canopy, receiving full light from above but little from the sides.
- **Intermediate** - a tree with a crown extending into the lower portions of the main crown canopy, but shorter than the codominants and receiving little direct light from above and none from the sides.
- **Suppressed** - a tree whose crown is entirely below the general level of the canopy and receives no direct light from either above or the sides.

**Crown condition** - An estimate of the tree crown's condition based upon the percent of the normal crown relative to total height; often called live crown ratio. Trees with live crowns less than 25% are considered poor condition; between 25% and 50% in fair condition; and in good condition if they have more than 50% live crown.

**Snags:** An estimate of forest structure and potential wildlife habitat. Snags were classified based on the following groups slightly modified from Bull et al. 1997:

- **Class I** – recently dead tree, fine branches often present, bark tight on tree, with little decay present.
- **Class II** – Bark loose or falling off of bole and branches, fine branches absent, larger limbs decaying or falling, decay in bole present.
- **Class III** – Small and large branches absent, most bark gone, in advanced stages of decay.

The inventory data was collected electronically using NEDLite (Knopp and Twery, 2006). Data was processed, and stand reports generated using NED-1 software (Simpson et al, 1995).

## Results

A total of 61 stands were mapped on the original natural community map that consisted of ten forest community types (Figure 1). Of the 61 forest stands, 18 were inventoried (29.5%) for a total of 399.7 acres of the 763 acres of forested covertype (52.4%).

Figure 1. Natural Communities of Great Bay National Wildlife Refuge based on Sperduto (2000).



Great Bay National Wildlife Refuge has a diverse forested habitat given its relatively small area. Twenty four overstory species were inventoried. The overstory species are dominated by northern red oak (17.6% of trees per acre), eastern white pine (16.5%), red maple (16.4%), shagbark hickory (12.8%), and black cherry (16.8%). Nineteen tree species account for the remaining 20% of stems per acre.

Most of the stands inventoried are overstocked, larger diameter stands (Table 1). This forest condition is common for stands that have had no active management for a long period of time. The distribution of size classes is not balanced, meaning that some size classes are under or over-represented.

An overstocked condition in a forest has several complicating factors. Stands that are overstocked tend to be less vigorous with too many trees competing for the limited resources present at a site. Less vigorous trees are more susceptible to primary and secondary pests, which further weaken and may kill trees. Overstocked stands often lack adequate regeneration in the understory. For species that are moderate to intolerant to shade, including paper birch, quaking aspen, and sweet birch that are present on GBNWR, the lack of sunlight in overstocked stands



creates an unbalanced age class distribution that could ultimately lead to the loss of these species in future stands.

Table 1. Characteristics of forest stands surveyed on Great Bay National Wildlife Refuge.

Natural Community	Stand Area	Forest Type	Size Class	Medial DBH	Canopy Closure (%)	Relative Density	Basal Area
Black gum-red maple basin swamp	14.4	<b>Not Sampled</b>					
Dry Appalachian oak-hickory forest	80.5	Other Hardwood	Small Sawtimber	12.36	93	116.7	140.0
Dry-mesic Appalachian oak-hickory forest	146.8	Other Hardwood	Small Sawtimber	16.34	97	109.9	153.3
Forest on Fill	12.5	Allegheny Hardwood	Small Sawtimber	16.04	63	62.9	115.0
Low red maple-elm/musclewood/ladyfern silt forest	69.2	Pine Hardwoods	Small Sawtimber	13.80	75	78.2	125.0
Mesic Appalachian oak-hickory forest	357.6	Other Mixedwood	Small Sawtimber	15.90	93	109.8	165.6
Plantation	25.4	Pine	Pole	8.78	80	90.1	156.0
Red maple/sensitive fern-tussock sedge basin/seepage	10.7	<b>Not Sampled</b>					
Red pine forest/woodland	7.7	Red Pine	Large Sawtimber	16.84	84	86.0	190.0
Seasonally saturated red maple swamp	38.2	Oak	Large Sawtimber	17.22	89	88.6	115.0

A measure of size class distribution is the  $q$  factor. The  $q$  factor is the ratio of numbers of trees between successive diameter classes. A  $q$  of 1.3 means that there are 1.3 times as many 10 inch trees as 11 inch trees, and that there are similar ratios between the other diameter classes. The range of  $q$  factors at the refuge were 1.14-1.26, with most below 1.2. In northeastern forest types,  $q$  factors between 1.3 and 1.8 (for 2 inch diameter classes) are frequently recommended for timber management. Values below 1.3 could be useful for wildlife and visual goals and are common on the refuge. At a low  $q$ , large trees occupy a relatively large proportion of the growing space. Consequently, regeneration is often limited in these stands as available resources are used by the dominant trees. Attempts to maintain a very low  $q$  may not be sustainable and future stands of similar types may be jeopardized. If current forest and stand conditions are considered the desired future condition, active management with long-term goals geared towards maintaining given forest types should be considered.

Cavity trees are vitally important to many types of wildlife; they provide nesting, roosting, and denning sites for approximately 25% of the wildlife species in the Northeast, including birds, mammals, reptiles, and amphibians (DeGraaf and Shigo 1985). Presence of cavities were tallied for live and dead trees, and are summarized in Table 2. Except for the red pine forest/woodland natural community, most of the cavities were in hardwood species, with a mixture of live and dead cavities. No cavities were recorded in the forest on fill, low red maple-elm/musclewood/ladyfern silt forest, or the plantation natural communities.



Snags were a common occurrence on GBNWR and occurred in all natural community types surveyed (Table 3). Class II snags were the most common and accounted for 61.6% of all snags. Class I (26.8%) and Class III (11.6%) were less frequently encountered. Snags are an important component of a healthy forest ecosystem and are used by a variety of invertebrates, vertebrates, and other organisms as habitat.

A summary of data collected for each natural community surveyed, including a description of the natural community, overstory narrative, and a timber narrative are included on pages 12 to 30.

Table 2. Description of tree cavities for the natural communities found on Great Bay National Wildlife Refuge.

Stand	Total # Cavities per Acre	Cavities in Live Trees	Cavities in Dead Trees	Cavities in Conifer Trees	Cavities in Hardwood Trees
Black gum-red maple basin swamp	Not Sampled				
Dry Appalachian oak-hickory forest	16.3	1.1	15.2	6.1	10.2
Dry-mesic Appalachian oak-hickory forest	5.1	0.3	4.8	0	5.1
Forest on Fill	0	0	0	0	0
Low red maple-elm/musclewood/ladyfern silt forest	0	0	0	0	0
Mesic Appalachian oak-hickory forest	3.1	2.7	0.4	0.3	2.8
Plantation	0	0	0	0	0
Red maple/sensitive fern-tussock sedge basin/seepage	Not Sampled				
Red pine forest/woodland	18.3	13.4	4.9	17.7	0.6
Seasonally saturated red maple swamp	23.5	23.5	0	0	23.5

Table 3. Snags by decay class for the natural communities found on Great Bay National Wildlife Refuge. See text for description of decay classes.

Stand Number	Snags per acre			
	Class I	Class II	Class III	Total
Black gum-red maple basin swamp	Not Sampled			
Dry Appalachian oak-hickory forest	0	12	19	31
Dry-mesic Appalachian oak-hickory forest	0	25	10	35
Forest on Fill	0	5	0	5
Low red maple-elm/musclewood/ladyfern silt forest	60	57	1	118
Mesic Appalachian oak-hickory forest	10	13	10	33
Plantation	34	127	0	161
Red maple/sensitive fern-tussock sedge basin/seepage	Not Sampled			
Red pine forest/woodland	0	0	2	2
Seasonally saturated red maple swamp	0	0	3	3

## Insect & Disease Surveys

Visual surveys for non-native insects were conducted on the inventory plots as well as on transects through the stands. Introduced insects of concern are the hemlock woolly adelgid, Asian longhorned beetle, emerald ash borer, and *Sirex noctilio*. These invasive species have been found in North America and several have caused serious economic and ecological impacts. While no evidence was found for these species during our initial survey period, in July 2007, two red pine were located in NHI point 67 that showed characteristics similar to trees attacked by *S. noctilio*. With permission from GBNWR, we removed one of these suspect trees, dissected the bole, and found no sign of *S. noctilio* larvae or adults in the wood. Because *S. noctilio* often attacks trees but does not oviposit, we have placed four semiochemical-baited traps within the stand to survey for presence of adult woodwasps. Results from this survey will be complete by December, 2007.

Native insects, including bark beetles and fall webworm were found on GBNWR. *Ips* spp. are bark beetles usually considered secondary species, but occasionally kill living trees when populations are epidemic. On GBNWR, *Ips* were found attacking severely suppressed red pine in one stand (NHI point 67). Codominant trees showed no sign of attack and likely will not be impacted by this beetle unless epidemic populations build in the surrounding area. However, given the small amount of pine in poor condition on the Refuge, it is unlikely *Ips* will become a primary tree killer. Another bark beetle, the Columbian timber beetle (*Corthylus columbianus* Hopkins), was found attacking mature red maple on GBNWR (NHI point 137). This ambrosia beetle attacks apparently healthy trees, but has little direct effect on tree health. Attacked trees are capable of tolerating the insect damage, but adult entrance holes often become inoculation points for other wood decay fungi. Wood products may be affected, but because high-value timber production is not the goal of GBNWR there should be no concern for the presence of this insect. Fall webworm, *Hyphantria cunea* (Drury), was noted on hardwoods, but populations of this insect rarely cause tree mortality.

Visual surveys for forest diseases were conducted as well. While lab confirmation was not possible, white pine showing symptoms of Caliciopsis pine canker, *Caliciopsis pinea* (Peck) infection were found in one stand (NHI point 157). This canker is thought to be a weak perennial fungus which attacks thin barked areas of the branch and bole, and while tree mortality is usually low, increased crown transparency and reduced crown density suggests tree vigor is being reduced by heavy infections of this disease. The canker was found in an overstocked pine stand, which is also a candidate for another pine pathogen, white pine blister rust, *Cronartium ribicola* (Fisch).

While not currently found on GBNWR, a pathogen threat to continue to monitor for is ash yellows. Ash yellows is caused by mycoplasmalike organisms that invade the vascular system of infected trees. Reported in New Hampshire and northeastern Massachusetts, this pathogen is a major threat to the ash resource. Symptoms include poor growth, reduced vigor, and premature mortality of infected trees. In severe cases, complete loss of the ash component of a stand can occur.



## Management Recommendations

There are several conifer plantations (red and white pine, white fir) that are overstocked. These plantations would benefit from a thinning to reduce the density and increase the vigor of the stands. They are currently stagnating, with evidence of decline agents present (*Caliciopsis* pine canker, *Ips* beetles). With no intervention, these stands will continue to decline and break up, with competing hardwoods eventually overtaking the site. This would eliminate the pure conifer component from the landscape. There are several silvicultural prescription options available, dependent upon the habitat goals of the refuge.

Many of the stands at GBNWR are mature, with low *q* factor values, or an uneven distribution of tree sizes. One simple management regime to address this would be to create wildlife openings in some of these stands. This technique will increase the range of vertical structure, as well as create conditions that favor more shade intolerant species. Small openings in several of these stands would create more habitat heterogeneity and diversify the habitat for species that favor early successional habitats. One factor to consider in opening up canopies is increased browse availability for deer. Deer browsing can influence future forest conditions by altering tree species composition, understory plant species richness, and abundance/distribution of invasive plant species (Augustine and Frelich 1998, Horsley et al. 2003, Rossell et al. 2007).

Mature stands create challenges to any recreation opportunities. With active recreation (i.e., hiking trails) traversing these types of stands, hazard tree management becomes an important issue. Older, unmanaged stands tend to have higher rates of failure on tree limbs with latent defects. If not previously undertaken, we recommend a hazard tree survey be completed in the high activity areas (e.g., parking areas and trail corridors). This survey may help prevent an incident, as well as lay the foundation for management of risk to the public.

## Natural Community Summary Overview

The following natural community summaries include basic metrics of the stand, a description of the natural community (taken from Sperduto 2004), and an overstory summary narrative. Many of the metrics and terminology in the overstory narrative are timber management oriented. They are presented here for use in comparison with other forested stands in northeastern forests. They can be used to forecast future conditions in these stands, and model ecological development. The types of habitats and vertical structure required for species of importance to the Refuge can be planned for and developed using these metrics.

The effective age of the natural community is computed using species specific growth factors related to size (diameter) of the tree at the time of inventory. An adjusted median age is calculated.

Acceptable growing stock are trees capable of producing sawtimber when it reaches appropriate size, whereas unacceptable growing stock is considered incapable of producing sawtimber at any time in future because of species, growth form, or current vigor.

## Black gum-red maple basin swamp

### Identification and Location

Stand ID: 1

Compartment: Black gum-red maple basin swamp

Date of inventory: **Not sampled**

### Measures

Area: 14.4 ac

### Natural Community Description

Black gum - red maple basin swamps are very similar in vegetation, soils, and hydrology to red maple - *Sphagnum* basin swamps. A principal distinction between these communities is the codominance of black gum with red maple in the canopy of black gum - red maple basin swamps. These swamps typically occur in perched upland till basins with watersheds smaller than one square mile. Species typical of acidic, relatively stagnant conditions are prevalent, but these swamps are highly variable in structure and composition ranging from forest (greater than 65% tree cover) to sparse woodland (10-25% tree cover). The shrub layer density increases in woodland and sparse woodland examples. Historical logging activities may also have influenced the structure and composition of some examples, and additional research on stand history is needed to clarify the relationships between land use history and current vegetation. Soils are typically acidic, nutrient-poor, very poorly drained Histosols (deep peat or muck) or poorly to very poorly drained mineral soils with histic epipedons. Peat is well decomposed near the surface, and pHs average approximately 4.4 (range: 3.7–5.3). Hummocks are well developed and average approximately 0.4 m high. There is little evidence of seepage or surface water flow in black gum swamps. Examples in lakeside settings may be influenced somewhat by surface flow, but water sources are generally restricted to precipitation, seasonal runoff or subsurface flow from surrounding uplands. Many of these swamps have stagnant outlet streams but no perennial inlets or streams running through them; others have neither inlets nor outlets.



## Dry Appalachian oak-hickory forest

### Identification and Location

Stand ID: 2

Compartment: Dry Appalachian oak-hickory forest

Date of inventory: 8/16/2006

### Measures

Area: 80.5 ac

Plot count: 5

Number of plot size classes: 2

Trees per acre: 736.36 #/ac

Basal area: 140.0 sq ft/ac

Relative density: 116.7 pct.

Canopy closure: 93%

### Stand Characteristics

Forest type: other hardwoods

Forest type for prescription: other

### Natural Community Description

These oak - hickory and oak forests occur in southern and south-central New Hampshire and are characterized by southern species that reach the northern extent of their ranges in this region. It is distinguished from dry red oak - white pine forests, which tend to lack significant representation of southern or Appalachian species. The ability of many oak species to root or stump sprout contributes to their perpetuation under regular fire regimes or harvests. Oak forests appear to be fire-dependant over long periods in other regions of the country. Some of these forests may succeed to other overstory species in time due to lack of adequate red oak regeneration, and from increases in beech on drier sites and sugar maple and beech on more mesic sites. Repeated fire would tend to knock back fire-sensitive species like beech and sugar maple. As such, any natural, semi-natural, and/or controlled fire regimes may be necessary for the long-term maintenance of oak and hickory on some sites. These forests are typically found on middle and upper slopes of low hills with acidic, well to excessively drained soils of low available nutrient status (oligotrophic). They are also common on slopes with south or west aspects. Known or potential soil series include Hollis, Shapleigh, Brimfield, Charlton, Canton, and perhaps Paxton soils.

### Overstory Summary Narrative

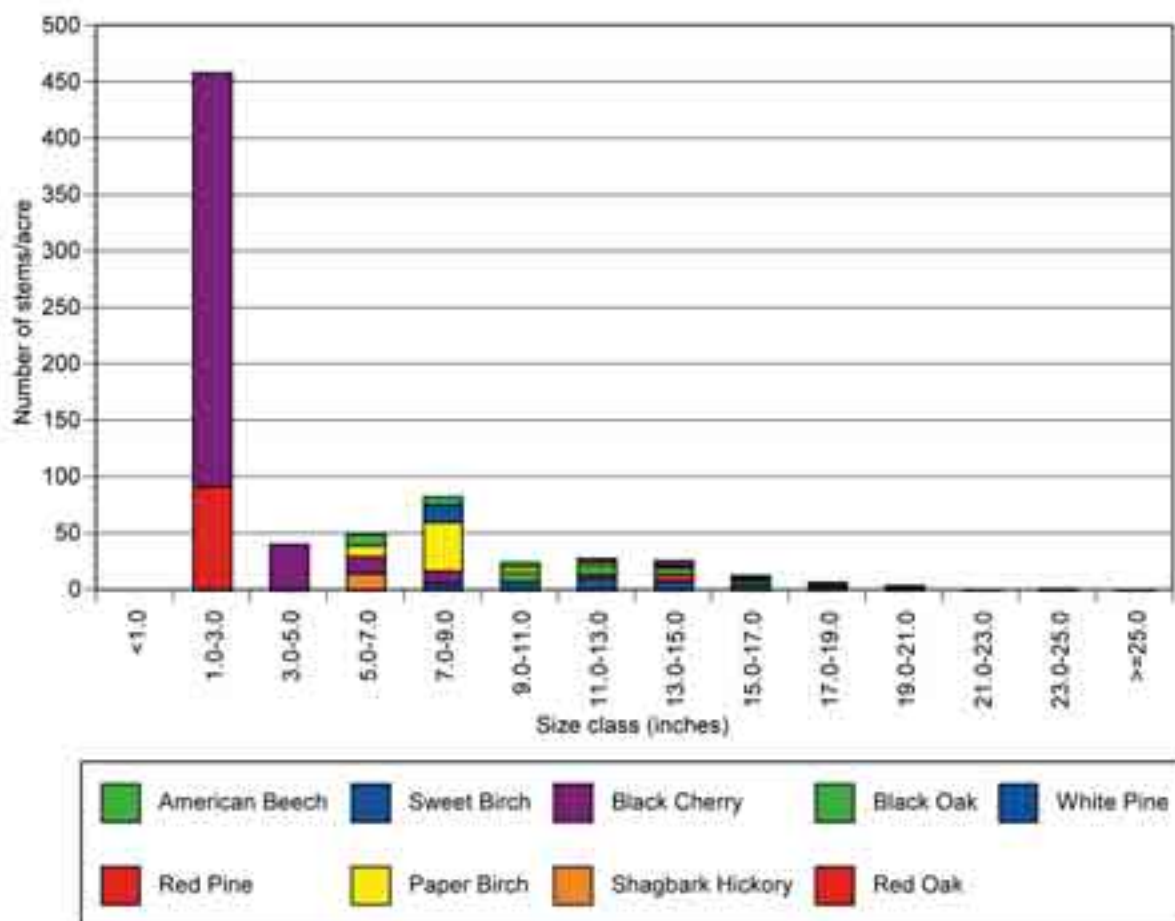
This dry Appalachian oak - hickory forest is currently considered mature and has a diverse group of tree species present. Effective stand age was estimated at 101 years. Species distribution by basal area was: eastern white pine (30%), northern red oak (14%), paper birch (14%), black oak (14%), black cherry (10%), American beech (6%), shagbark hickory (6%), sweet birch (4%), and red pine (1%).

In a timber management setting, this natural community would be considered small sawtimber having a medial stand diameter of 12.36 in. Relative stand density was 116.7 percent of the average maximum stocking expected in undisturbed stands of similar size and species. This

density is well above the optimum for best individual tree growth. At this relative density, growth rate of the biggest trees is probably moderate, while growth of medium and smaller-sized trees is probably fair, and mortality due to crowding moderate. Mortality due to crowding will add important structure to the stand.

The growing stock amounted to 114.0 sq ft/ac. Gross total volume in all trees to a 4 inch top was 2898.2 cu.ft/ac. There were 736 trees/ac in this stand. The basal area of acceptable growing stock was 114.0, while unacceptable growing stock represented 26.0 sq ft/ac of basal area. Acceptable growing stock represented 80.1 of the relative density, while unacceptable growing stock represented 36.7 of the relative density. The  $q$  factor for this stand was 1.25.

The mean diameter of this dry Appalachian oak-hickory forest was 3.94. The quadratic mean diameter was 5.90. The net board foot volume of this stand was 10,209 bd.ft/ac and 24% of the basal area were considered of high value. Trees of acceptable quality for future growing stock provide a fully stocked stand by themselves.



## Dry-mesic Appalachian oak-hickory forest

### Identification and Location

Stand ID: 3

Compartment: Dry-mesic Appalachian oak-hickory forest

Date of inventory: 9/21/2006

### Measures

Area: 146.8 ac

Plot count: 6

Number of plot size classes: 2

Trees per acre: 344.94 #/ac

Basal area: 153.3 sq ft/ac

Relative density: 109.9 pct.

Canopy closure: 97%

### Stand Characteristics

Forest type: other hardwoods

Size class: small sawtimber

### Natural Community Description

This community occurs on dry-mesic sites in coastal and southern New Hampshire and is characterized by a broad diversity of trees, including Appalachian (central hardwood) oaks, hickories, white pine, and transitional hardwood trees. The shrub and herb layers are sparse to moderately well developed. Heaths and other dry site understory plants are absent or in low abundance, as are species characteristic of more northern forests, such as sugar maple, yellow birch, and wood ferns (*Dryopteris* spp.). Soils range from well drained sandy to very fine sandy loams (such as Eldridge, Chatfield-Hollis, and Pennichuck series) on gentle to moderate slopes.

### Overstory Summary Narrative

This dry-mesic Appalachian oak – hickory is currently considered mature. Effective stand age was estimated to be 158 years. There were eleven tree species present in the stand, with the following species distribution by basal area: eastern white pine (29%), northern red oak (25%), shagbark hickory (13%), pignut hickory (10%), sweet birch (9%), black oak (5%), paper birch (3%), white ash (2%), black cherry (1%), white oak (1%), and eastern hemlock (1%).

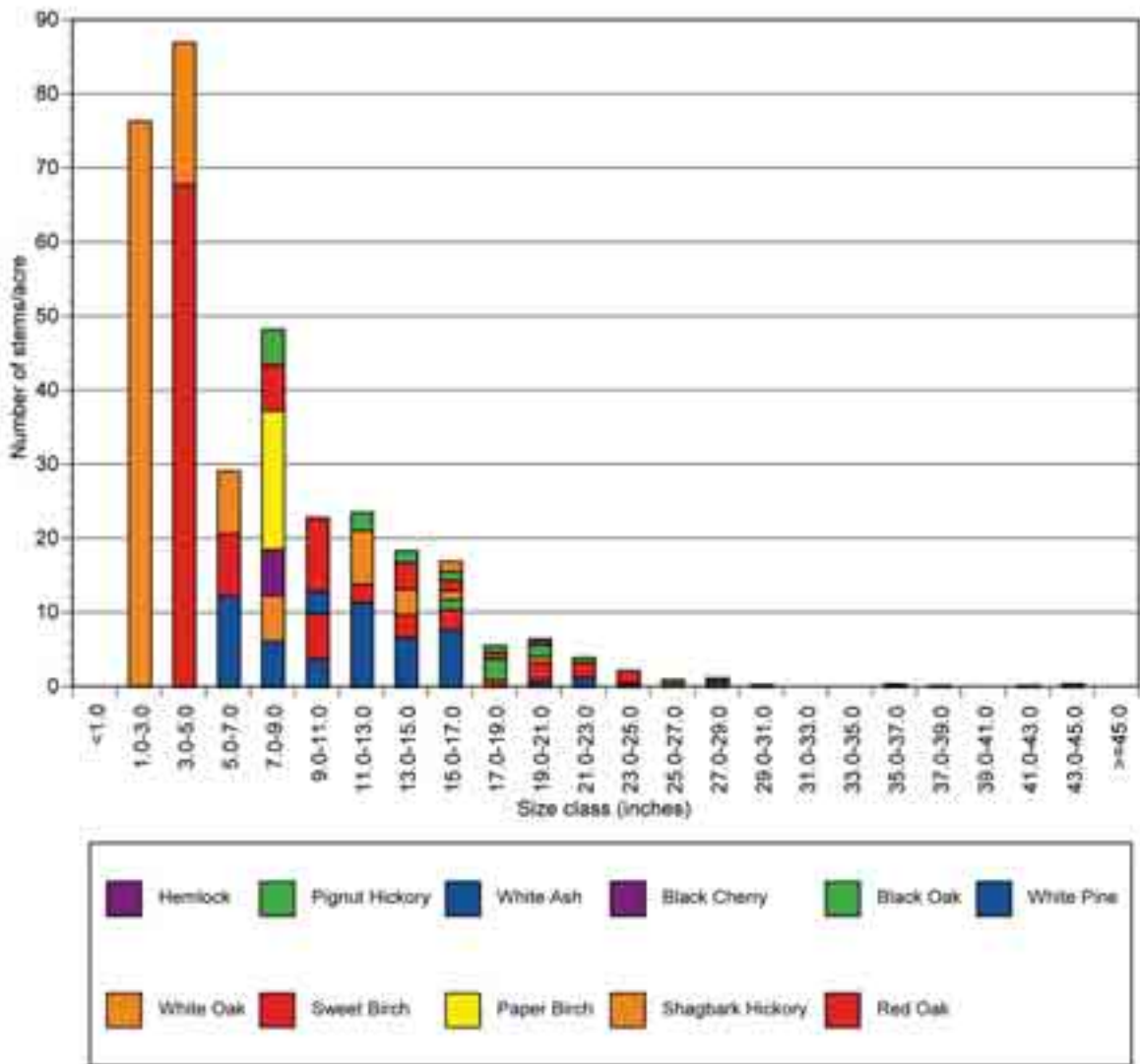
In a timber management setting, this natural community would be considered small sawtimber, having a medial stand diameter of 16.34 in. Relative stand density was 109.9 percent of the average maximum stocking expected in undisturbed stands of similar size and species. This density is well above the optimum for best individual tree growth. At this relative density, growth rate of the biggest trees is probably moderate, while growth of medium and smaller-sized trees is probably fair, and mortality due to crowding moderate. If this natural community is managed under an even-age silvicultural system, the several species groups will mature at about the same time.

The growing stock amounted to 138.3 sq ft/ac. Gross total volume in all trees to a 4 inch top was 3049.6 cu.ft/ac. There were 345 trees/ac in this stand. The basal area of acceptable growing



stock was 138.3, while unacceptable growing stock represented 15.0 sq ft/ac of basal area. Acceptable growing stock represented 101.7 of the relative density, while unacceptable growing stock represented 8.2 of the relative density. The *q* factor for this stand was 1.15.

The mean diameter of this dry-mesic Appalachian oak-hickory forest was 7.01. The quadratic mean diameter was 9.03. The net board foot volume of this stand was 10,245 bd.ft/ac and 27% of the basal area in this stand were considered of high value. Trees of acceptable quality for future growing stock provide a fully stocked stand by themselves.



## Forest on Fill

### Identification and Location

Stand ID: 4

Compartment: Forest on fill

Date of inventory: 9/22/2006

### Measures

Area: 12.5 ac

Plot count: 2

Number of plot size classes: 1

Trees per acre: 139.36 #/ac

Basal area: 115.0 sq ft/ac

Relative density: 62.9 pct.

Canopy closure: 63%

### Stand Characteristics

Forest type: Allegheny hardwoods

Size class: small sawtimber

### Natural Community Description

This community is highly variable, existing on extremely disturbed sites. Species typically are planted varieties, recruited from neighboring stands, or introduced invasive and pioneer. Physical characteristics of nutrient cycles and drainage may have been altered during the disturbance, rendering the community different from its original as well as neighboring communities.

### Overstory Summary Narrative

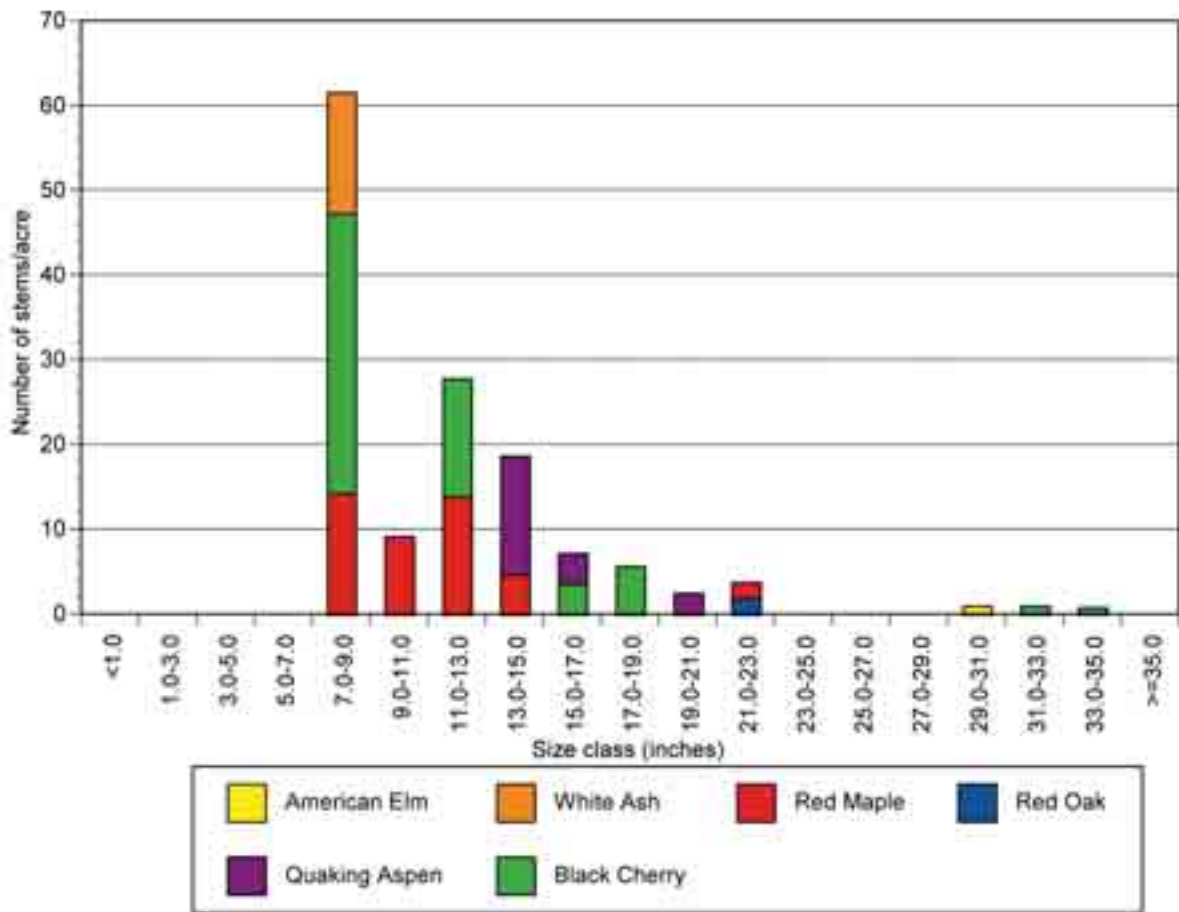
This Allegheny hardwoods stand is currently considered mature. Effective stand age was estimated to be 125 years. There were six tree species present in the stand with the following species distribution by basal area: black cherry (39%), red maple (26%), quaking aspen (22%), northern red oak (4%), white ash (4%), and American elm (4%).

In a timber management setting, this natural community would be considered small sawtimber having a medial stand diameter of 16.04 in. Relative stand density was 62.9 percent of the average maximum stocking expected in undisturbed stands of similar size and species. This density is in the optimum range for optimal individual tree growth. At this relative density, growth rate of the biggest trees is probably excellent, while growth rate of medium and smaller-sized trees is probably good and mortality due to crowding low.

The growing stock amounted to 95.0 sq ft/ac. Gross total volume in all trees to a 4 inch top was 2535.0 cu.ft/ac. There were 139 trees/ac in this stand. The basal area of acceptable growing stock was 95.0, while unacceptable growing stock represented 20.0 sq ft/ac of basal area. Acceptable growing stock represented 50.2 of the relative density, while unacceptable growing stock represented 12.7 of the relative density. The overall stand relative density was 62.9. The *q* factor for this stand was 1.14.



The mean diameter of this forest on fill forest was 11.36. The quadratic mean diameter was 12.30. The net board foot volume of this stand was 6882 bd.ft/ac and 43% of the basal area in this stand were considered of high value. Trees of acceptable quality for future growing stock are inadequate to provide a fully stocked stand in themselves.



## Low red maple-elm/musclewood/ladyfern silt forest

### Identification and Location

Stand ID: 5

Compartment: Low red maple-elm/musclewood/ladyfern silt forest

Date of inventory: 05/23/2007

### Measures

Area: 69.2 ac

Plot count: 4

Number of plot size classes: 3

Trees per acre: 422.81 #/ac

Basal area: 125.0 sq ft/ac

Relative density: 78.2 pct.

Canopy closure: 75%

### Stand Characteristics

Forest type: pine hardwoods

Size class: small sawtimber

### Natural Community Description

This forest type is intermediate between upland and wetland communities. It has a seasonally high water table and silt soils with a high water holding capacity and intermediate nutrient status. The vegetation consists of a moderately diverse combination of upland, moist-site forest species and facultative wetland species. The woody and herbaceous understories are sparse to moderately well developed. Unlike most swamps, there is very little or no organic soil horizon or hummock-hollow microtopography development. Soils are somewhat poorly drained silt loams with a seasonally high water table, high moisture holding capacity due to the silt content, and moderate base-cation status judging from species composition and silty soils. Soil types include some Buxton and Scitico silt loams (of marine origin), among other soils. There is typically no or a very shallow O horizon (<2 cm), very dark gray-black silt loam A horizon, and olive gray silt loam B horizon with redoxymorphic features (mottles) found near the transition to the B horizon. One example has a distinct plow layer, although others have a more distinct horizon development and have not been plowed. This community is similar in some respects to somewhat poorly drained floodplains forests and seepage forests, but are not flooded and do not have mucky organic horizons. It is also similar to hemlock – cinnamon fern and red maple - red oak - cinnamon fern forests in terms of drainage class.

### Overstory Summary Narrative

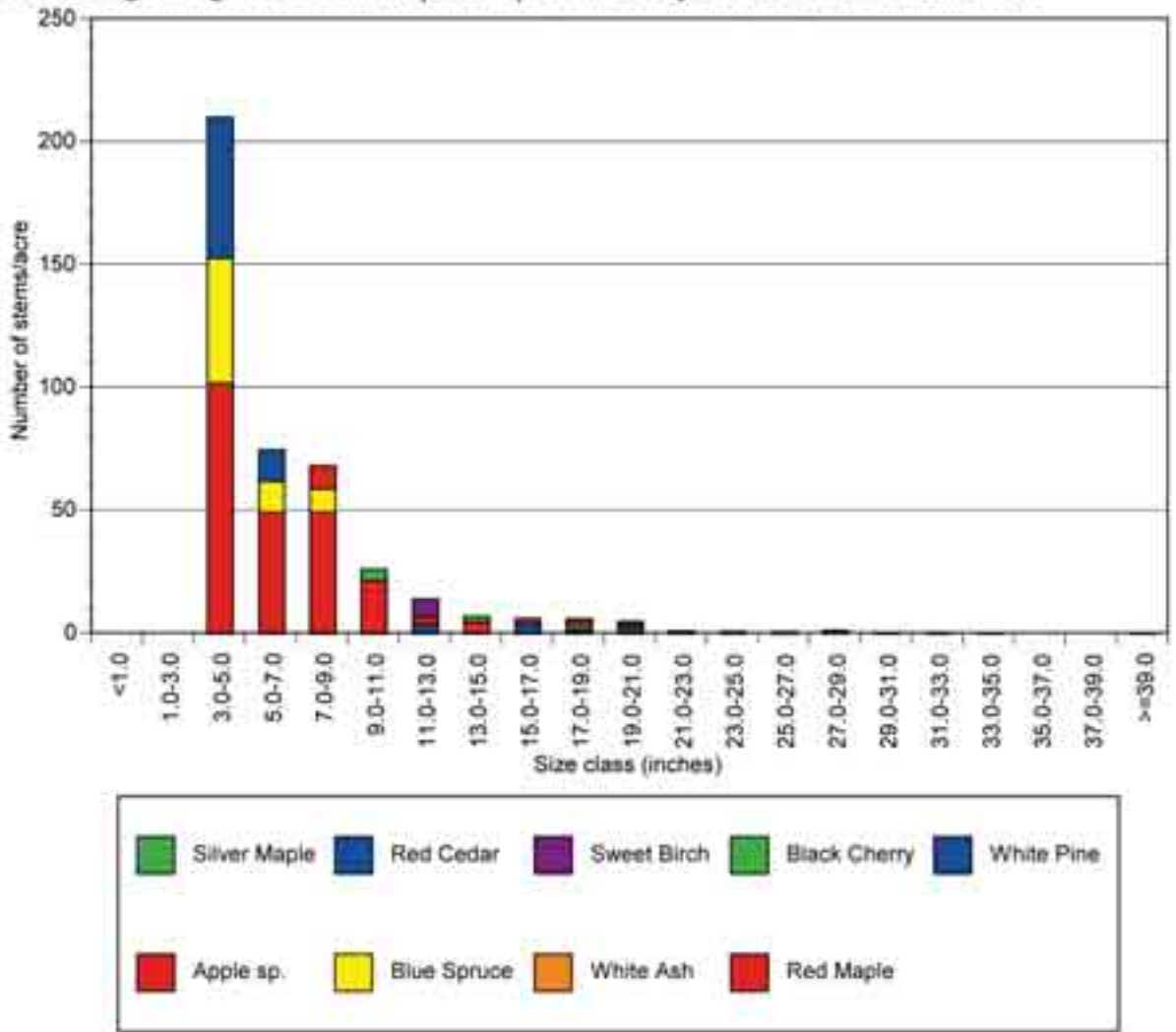
This pine hardwoods stand is currently considered mature. Effective stand age was estimated at 156 years. Nine tree species were present in the stand with the following species distribution by basal area: red maple (40%), eastern white pine (28%), black cherry (6%), blue spruce (6%), redcedar (6%), apple sp. (6%), sweet birch (4%), white ash (2%), and silver maple (2%).

In a timber management setting, this natural community would be considered small sawtimber stand, having a medial stand diameter of 13.80 in. Relative stand density was 78.2 percent of the average maximum stocking expected in undisturbed stands of similar size and species. This

density is in the optimum range for best individual tree growth. At this relative density, growth rate of the biggest trees is probably excellent, while growth rate of medium and smaller-sized trees is probably good and mortality due to crowding low.

The growing stock amounted to 87.5 sq ft/ac. Gross total volume in all trees to a 4 inch top was 2133.9 cu.ft/ac. There were 423 trees/ac in this stand. The basal area of acceptable growing stock was 87.5, while unacceptable growing stock represented 37.5 sq ft/ac of basal area. Acceptable growing stock represented 56.2 of the relative density, while unacceptable growing stock represented 22.1 of the relative density. The *q* factor for this stand was 1.19.

The mean diameter of this low red maple-elm/musclewood/ladyfern silt forest was 6.01. The quadratic mean diameter was 7.36. The net board foot volume of this stand was 5760 bd.ft/ac and 6% of the basal area in this stand were considered of high value. Trees of acceptable quality for future growing stock are inadequate to provide a fully stocked stand in themselves.





## Mesic Appalachian oak-hickory forest

### Identification and Location

Stand ID: 6

Compartment: Mesic Appalachian oak-hickory forest

Date of inventory: 8/17/2006

### Measures

Area: 357.6 ac

Plot count: 9

Number of plot size classes: 2

Trees per acre: 234.98 #/ac

Basal area: 165.6 sq ft/ac

Relative density: 109.8 pct.

Canopy closure: 93%

### Stand Characteristics

Forest type: other mixedwoods

Size class: small sawtimber

### Natural Community Description

This community occurs on mesic sites in coastal and southern New Hampshire and is characterized by a broad diversity of trees, including Appalachian (central hardwood) oaks, hickories, white pine, and transitional hardwood trees. The shrub and herb layers are sparse to moderately well developed. Heaths and other dry site understory plants are absent or in low abundance, as are species characteristic of more northern forests, such as sugar maple, yellow birch, and wood ferns (*Dryopteris* spp.). Soils range from well drained sandy to very fine sandy loams (such as Eldridge, Chatfield-Hollis, and Pennichuck series) and moderately well drained silt loams (such as Scitico and Boxford silt loams) on gentle to moderate slopes. The moisture regime of sandy loams tends to be dry-mesic and the silt loams tend to be mesic.

### Overstory Summary Narrative

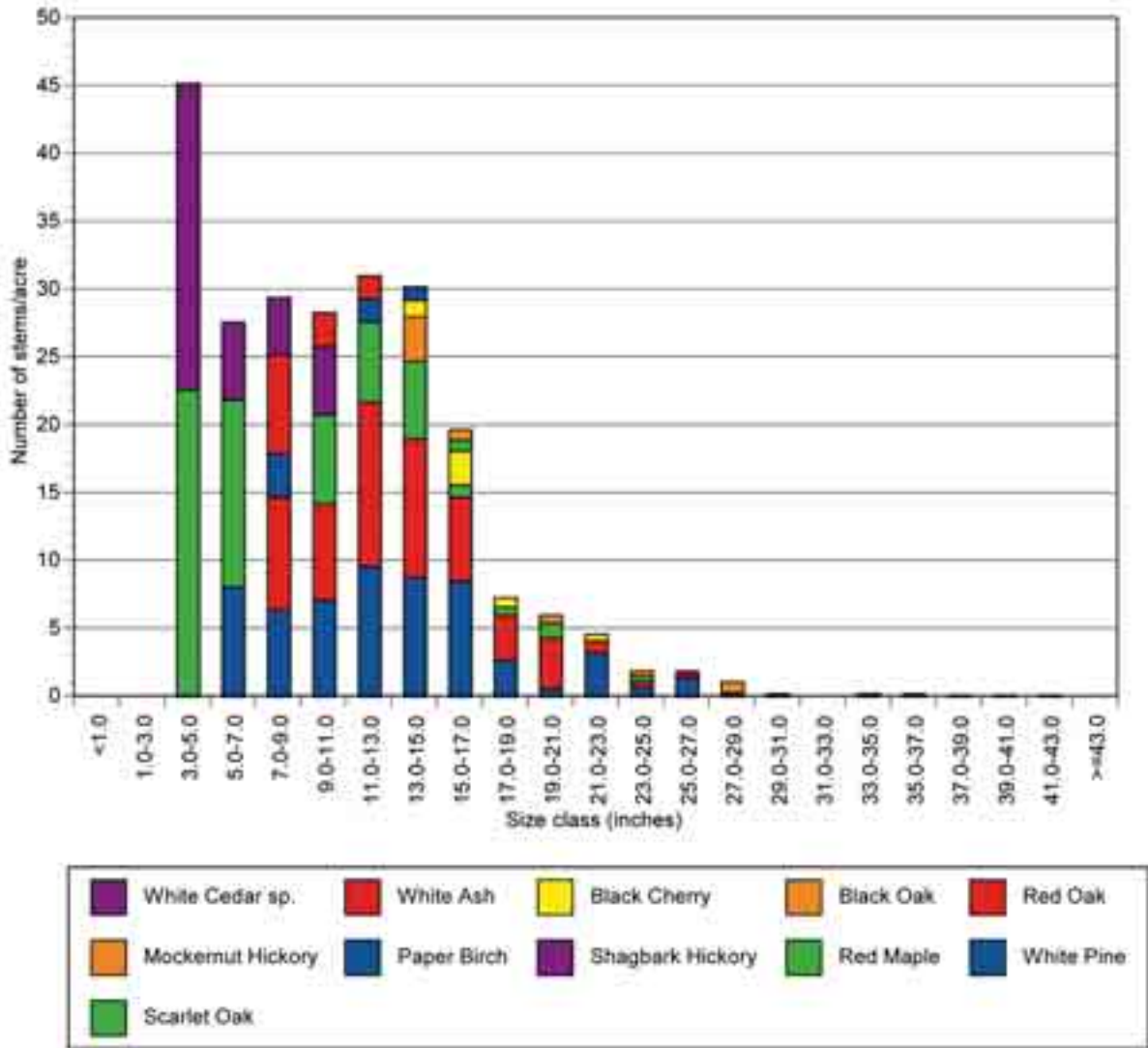
This mesic Appalachian oak-hickory forest is currently considered mature. Effective stand age was estimated at 131 years. There were 11 tree species present in the stand with the following species distribution by basal area: eastern white pine (34%), northern red oak (32%), red maple (14%), black oak (6%), black cherry (4%), shagbark hickory (3%), white ash (3%), paper birch (2%), scarlet oak (1%), mockernut hickory (1%), and white-cedar sp. (1%).

In a timber management setting this natural community would be considered a sawtimber stand, with a medial stand diameter of 15.90 in. Relative stand density was 109.8 percent of the average maximum stocking expected in undisturbed stands of similar size and species. This density is well above the optimum for best individual tree growth. At this relative density, growth rate of the biggest trees is probably moderate, while growth of medium and smaller-sized trees is probably fair, and mortality due to crowding moderate.

The growing stock amounted to 137.8 sq ft/ac. Gross total volume in all trees to a 4 inch top was 3606.4 cu.ft/ac. There were 235 trees/ac in this stand. The basal area of acceptable growing

stock was 137.8, while unacceptable growing stock represented 27.8 sq ft/ac of basal area. Acceptable growing stock represented 93.0 of the relative density, while unacceptable growing stock represented 16.7 of the relative density. The *q* factor for this stand was 1.18.

The mean diameter of this mesic Appalachian oak-hickory forest was 9.90. The quadratic mean diameter was 11.37. The net board foot volume of this stand was 13,882 bd.ft/ac and 36% of the basal area in this stand were considered of high value. Trees of acceptable quality for future growing stock provide a fully stocked stand by themselves.





## Plantation

### Identification and Location

Stand ID: 7

Compartment: Plantation

Date of inventory: 9/19/2006

### Measures

Area: 25.4 ac

Plot count: 5

Number of plot size classes: 2

Trees per acre: 467.51 #/ac

Basal area: 156.0 sq ft/ac

Relative density: 90.1 pct.

Canopy closure: 80%

### Stand Characteristics

Forest type: pine

Size class: pole

### Natural Community Description

This forest type is an artificial community, planted typically in a monoculture and mainly of conifer species. They are often planted in rows, adding to the artificial appearance. Plantations are typically used in production forests, where maximum wood fiber is the objective, or in watershed protection.

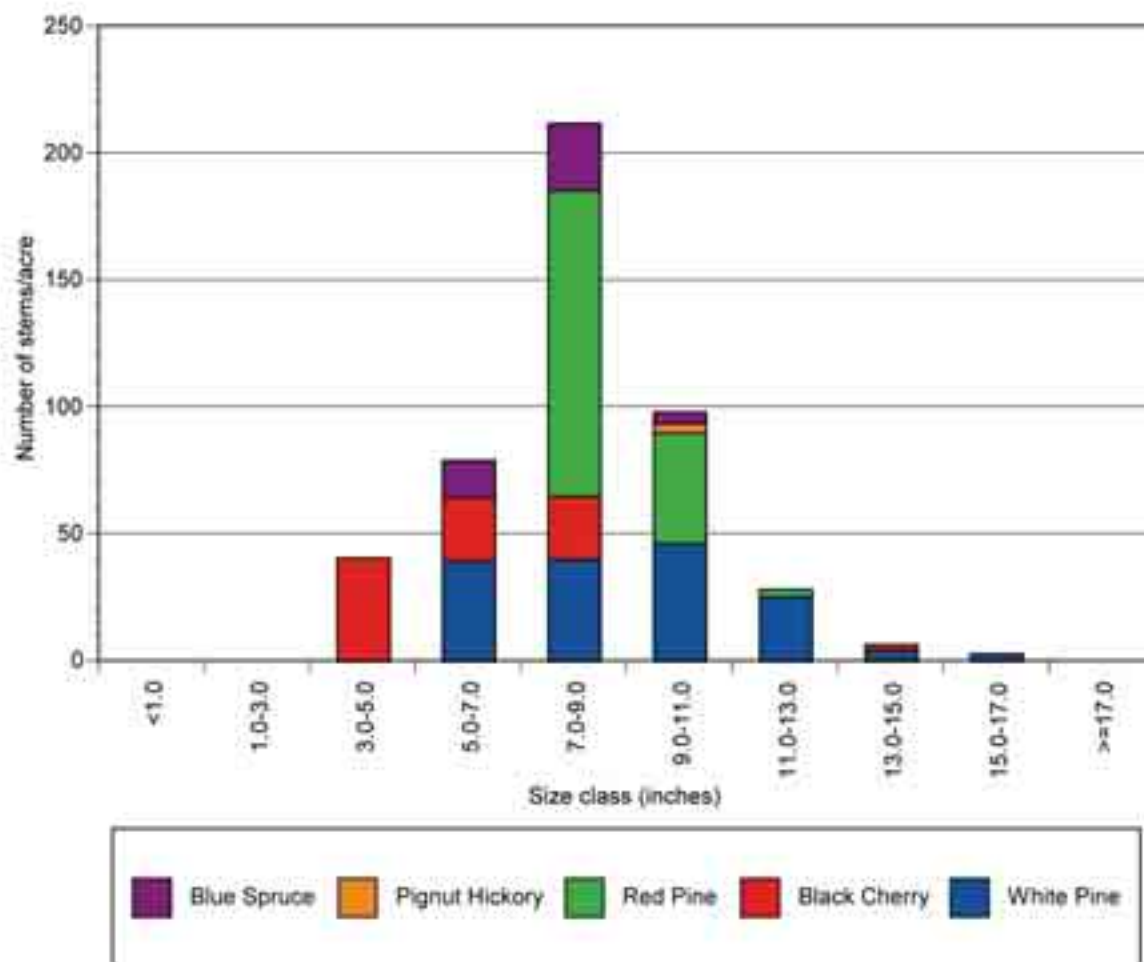
### Overstory Summary Narrative

This pine plantation is currently considered mature. Effective stand age was estimated at 66 years. There were five tree species present in the stand with the following species distribution by basal area: eastern white pine (44%), red pine (37%), black cherry (10%), blue spruce (8%), and pignut hickory (1%).

In a timber management setting this natural community would be considered a pole stand, with a medial stand diameter of 8.78 in. Relative stand density was 90.1 percent of the average maximum stocking expected in undisturbed stands of similar size and species. This density is higher than optimum for best individual tree growth. At this relative density, growth rate of the biggest trees is probably moderate, while growth of medium and smaller-sized trees is probably fair, and mortality due to crowding moderate.

The growing stock amounted to 128.0 sq ft/ac. Gross total volume in all trees to a 4 inch top is 2338.0 cu.ft/ac. There were 468 trees/ac in this stand. The basal area of acceptable growing stock was 128.0, while unacceptable growing stock represented 28.0 sq ft/ac of basal area. Acceptable growing stock represented 71.4 of the relative density, while unacceptable growing stock represented 18.6 of the relative density. The overall stand relative density was 90.1. The  $q$  factor for this stand was 1.26.

The mean diameter of this pine plantation was 7.48. The quadratic mean diameter was 7.82. The net board foot volume of this stand was 2086 bd.ft/ac and 10% of the basal area in this stand were considered of high value. Trees of acceptable quality for future growing stock are inadequate to provide a fully stocked stand in themselves.



## Red maple/sensitive fern-tussock sedge basin/seepage

### Identification and Location

Stand ID: 8

Compartment: Red maple/sensitive fern-tussock sedge basin/seepage

Date of inventory: **Not sampled**

### Measures

Area: 10.7 ac

Plot count: 0

Number of plot size classes: 0

### Natural Community Description

This is a common type of red maple swamp characterized by a diverse assemblage of herbaceous species, relatively little *Sphagnum* moss, and saturated or seasonally saturated to seasonally flooded soils. The swamps may be small or very large (10-100 acres) and typically occupy headwater basins that give rise to drainages or along drainages where seepage or non-channelized upland runoff contributes to the water budget. It lacks seasonal flooding from over-bank flooding (typical of seasonally flooded red maple swamps) and is more minerotrophic than red maple - *Sphagnum* basin swamps. *Onoclea sensibilis* (sensitive fern) is a good indicator of minerotrophic conditions in this type. Subsurface groundwater discharge is likely in at least some of these swamps. These swamps are often found with other swamp communities in a larger mosaic.



## Red pine forest/woodland

### Identification and Location

Stand ID: 9

Compartment: Red pine forest/woodland

Date of inventory: 8/16/2006

### Measures

Area: 7.7 ac

Plot count: 3

Number of plot size classes: 1

Trees per acre: 139.51 #/ac

Basal area: 190.0 sq ft/ac

Relative density: 86.0 pct.

Canopy closure: 84%

### Stand Characteristics

Forest type: red pine

Size class: large sawtimber

### Natural Community Description

Red pine dominated forests and woodlands are most prominent on dry, montane rocky ridges, outcrops, and summits where acidic, nutrient-poor conditions prevail. Red pine stands are often evenaged and have park-like understories with a low heath shrub layer. Even-aged cohorts typically develop following an intense fire. This community is most common on southerly aspects, ranging from west to south to east, between 750-2700 ft. elevation. Typical examples consist of mosaics of open or partially vegetated rock outcrops interspersed with a scattered or patchy tree canopy. Rock exposures generally cover 25-50% of the ground surface. In some areas, particularly those with deeper soils or ones that have only a distant fire-history, red pine may form an essentially closed canopy. Red pine trees may exceed 60-70 ft (18-21 m) in height, but are, on average, shorter in woodland settings and at higher elevations. A closed forest canopy may form in the absence of fire for long periods or where soils are more well developed. Shade-intolerant species tend to be less abundant or absent in forested examples [e.g., *Corydalis sempervirens* (pale corydalis), *Potentilla tridentata* (three-toothed cinquefoil), *Deschampsia flexuosa* (common hair-grass), and *Danthonia spicata* (poverty oat-grass)]. Fire plays an important role in the formation and maintenance of this community, and controlled burns or wildfire may be required for substantial regeneration of red pine, whether or not harvesting is performed. Red pine can exceed 200 years of age, and its thick, platy bark affords mature trees some protection from fire when trees reach about 70 years of age. Younger trees have thinner bark and may not survive an intense fire. Several native red pine forests occur in central New Hampshire on deep sandy kame terraces with very little bedrock exposure. These are classified as red pine - white pine - balsam fir forests. Red pine is less frequent in sand plain settings relative to montane outcrops. Although individual red pine trees may be found in southern New Hampshire, native stands are rare or absent. Some outcrops in other landscape positions, such as along rocky lake shores, exhibit similar vegetation and are included in this type. Soils are thin, dry, and acidic with turfy (fibric) organic surface horizons and gravelly and/or coarse sand mineral layers over acidic to intermediate bedrock (oligotrophic). This is a distinct, narrowly defined community that intergrades with other northern rocky ridge communities. It is

considered distinct from the red oak and jack pine types due to differences in dominant tree species and probable differences in ecological histories or circumstances.

#### Overstory Summary Narrative

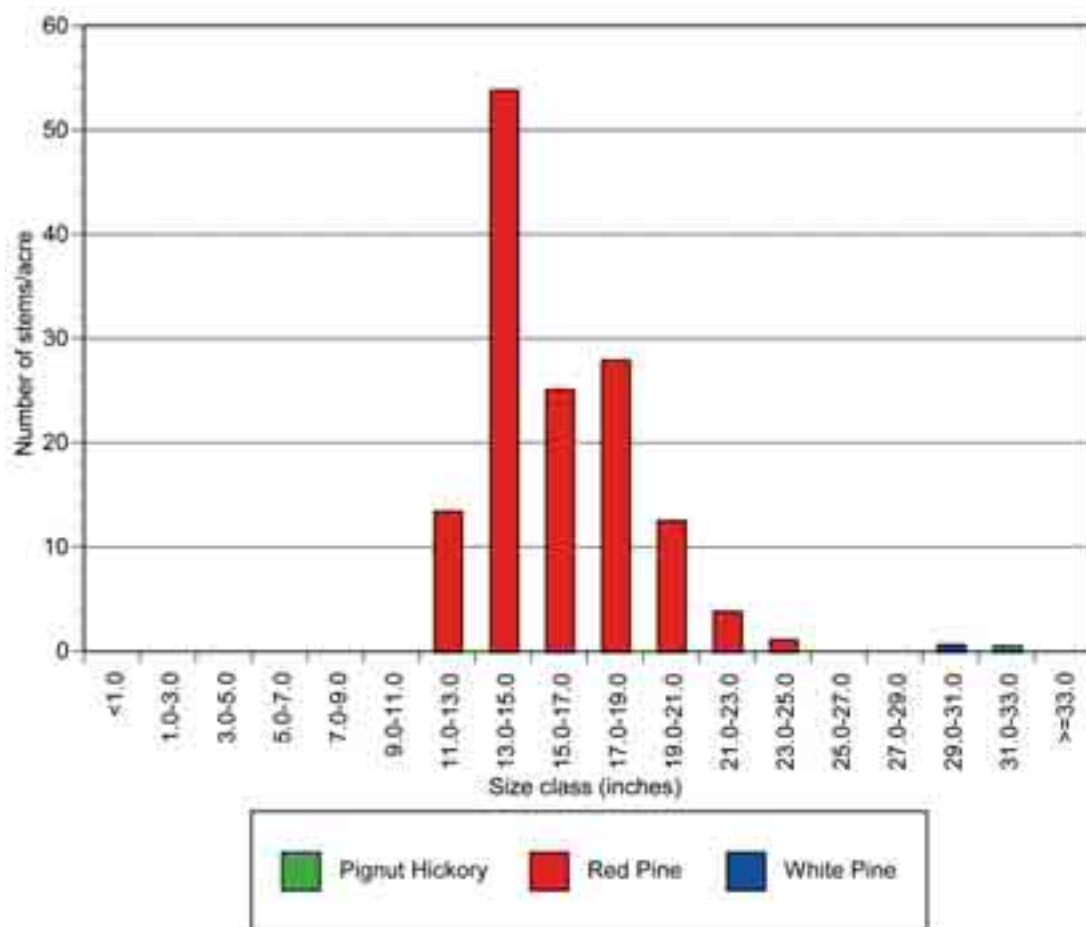
This red pine forest/woodland is currently considered mature. Effective stand age was estimated at 126 years. There were three tree species present in the stand with the following species distribution by basal area: red pine (96%), eastern white pine (2%), and pignut hickory (2%).

In a timber management setting this natural community would be considered a large sawtimber stand, with a medial stand diameter of 16.84 in. Relative stand density was 86.0 percent of the average maximum stocking expected in undisturbed stands of similar size and species. This density is higher than optimum for best individual tree growth. At this relative density, growth rate of the biggest trees is probably moderate, while growth of medium and smaller-sized trees is probably fair, and mortality due to crowding moderate.

The growing stock amounted to 183.3 sq ft/ac. Gross total volume in all trees to a 4 inch top was 4723.1 cu.ft/ac. There were 140 trees/ac in this stand. The basal area of acceptable growing stock was 183 sq ft/ac, while unacceptable growing stock represented 6.7 sq ft/ac of basal area. Acceptable growing stock represented 82.8 of the relative density, while unacceptable growing stock represented 3.2 of the relative density. The overall stand relative density was 86.0. The  $q$  factor for this stand was 1.19.

The mean diameter of this red pine forest/woodland was 15.50. The quadratic mean diameter was 15.80. The net board foot volume of this stand was 24,659 bd.ft/ac and none of the basal area of the trees in this stand were considered of high value. Trees of acceptable quality for future growing stock provide a fully stocked stand by themselves.





## Seasonally saturated red maple swamp

### Identification and Location

Stand ID: 10

Compartment: Seasonally saturated red maple swamp

Date of inventory: 8/17/2006

### Measures

Area: 38.2 ac

Plot count: 2

Number of plot size classes: 1

Trees per acre: 231.60 #/ac

Basal area: 115.0 sq ft/ac

Relative density: 88.6 pct.

Canopy closure: 89%

Size class: large sawtimber

### Natural Community Description

This community occurs in somewhat poorly drained mineral soil settings in transition zones between wetland and upland communities. It is dominated by hardwood trees, particularly red maple, oaks, and birches, with a relatively minor component of pine and hemlock. *Osmunda cinnamomea* (cinnamon fern) and tall wetland shrubs such as *Vaccinium corymbosum* (highbush blueberry) are present in moderate abundance (~1-15%). Other wetland plants are sparse. More coastal or southern examples contain Appalachian oaks, hickories, and possibly black huckleberry, which are absent from central NH examples. Soils consist of sand, sandy loams and silt loams, typically with a dark brown or black A horizon over B horizon materials with mottling within ~30 cm of the surface. This community is typically somewhat poorly drained, and therefore intermediate and transitional to more well drained upland forests and poorly or very poorly drained swamps. Soils series include Pipestone sand, Boxford silt loam, and possibly Raynham silt loam and Eldridge fine sandy loam.

### Overstory Summary Narrative

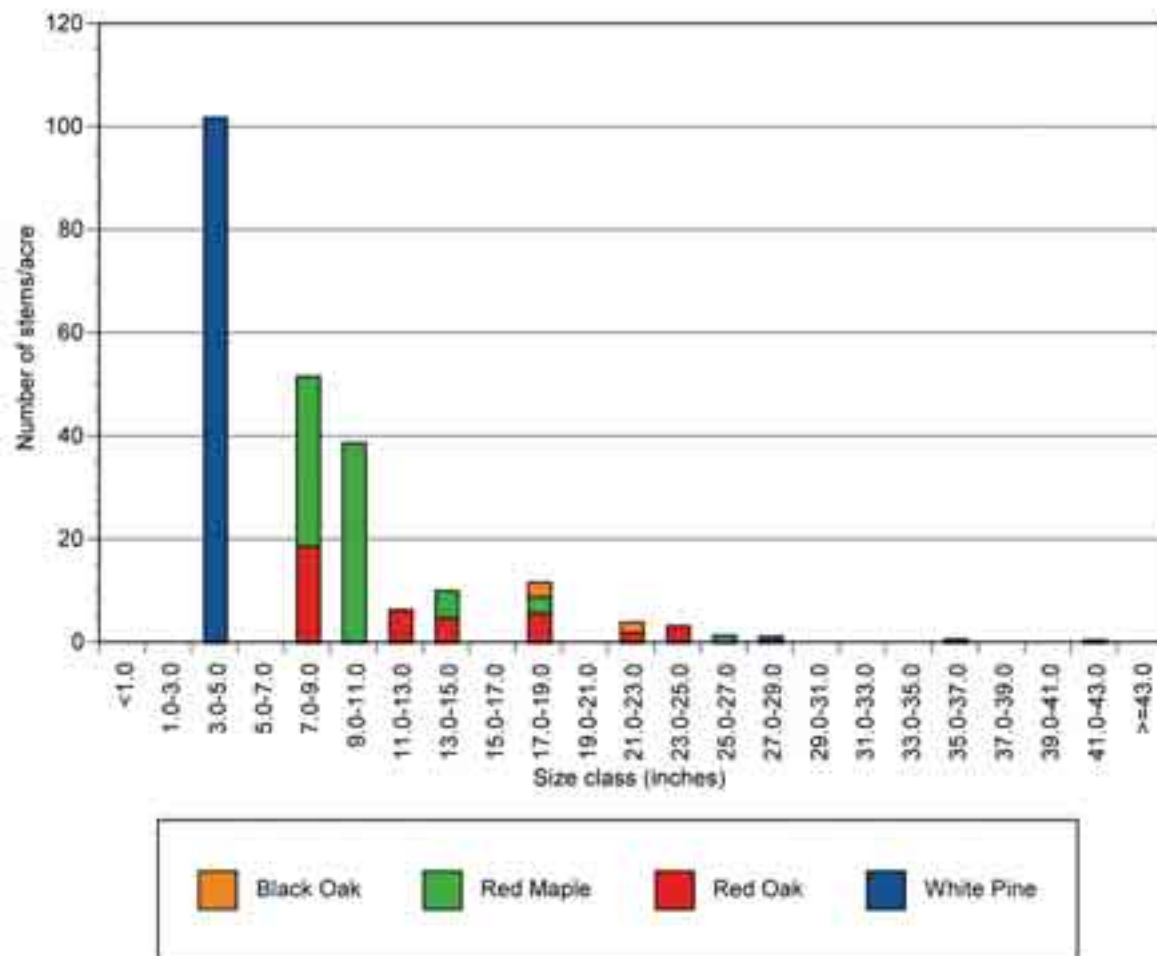
This seasonally saturated red maple swamp is currently considered mature. Effective stand age was estimated at 156 years. There were four tree species present in the stand with the following species distribution by basal area: northern red oak (39%), red maple (39%), black oak (13%), and eastern white pine (9%).

In a timber management setting this natural community would be considered a large sawtimber stand, with a medial stand diameter of 17.22 in. Relative stand density was 88.6 percent of the average maximum stocking expected in undisturbed stands of similar size and species. This density is higher than optimum for best individual tree growth. At this relative density, growth rate of the biggest trees is probably moderate, while growth of medium and smaller-sized trees is probably fair, and mortality due to crowding moderate.

The growing stock amounted to 100.0 sq ft/ac. Gross total volume in all trees to a 4 inch top was 2617.7 cu.ft/ac. There were 232 trees/ac in this stand. The basal area of acceptable growing stock was 100.0, while unacceptable growing stock represented 15.0 sq ft/ac of basal area.

Acceptable growing stock represented 77.6 of the relative density, while unacceptable growing stock represented 11.0 of the relative density. The overall stand relative density was 88.6. The  $q$  factor for this stand was 1.14.

The mean diameter of this seasonally saturated red maple swamp was 7.59. The quadratic mean diameter was 9.54. The net board foot volume of this stand was 9419 bd.ft/ac, and 39% of the basal area in this stand were considered of high value. Trees of acceptable quality for future growing stock are inadequate to provide a fully stocked stand in themselves.



## References

- Augustine, D.J. and L.E. Frelich. 1998. Effects of white-tailed deer on populations of an understory forb in fragmented deciduous forests. *Conservation Biology*. 12: 995-1004.
- Avery, E.A. and H.E. Burkhart. 1983. *Forest Measurements*. McGraw-Hill Book Company, New York. 331p.
- Bull E. L., C. G. Parks, and T. R. Torgersen. 1997. Trees and logs important to wildlife in the interior Columbia River Basin. General Technical Report, PNW-GTR-391. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR. 55 p.
- DeGraaf, R. M. and A. L. Shigo. 1985. Managing cavity trees for wildlife in the northeast. General Technical Report NE-101. U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station, Broomall, PA. 21 p.
- Horsley, S.B., S.L. Stout, and D.S. deCalesta. 2003. White-tailed deer impact on the vegetation dynamics of a northern hardwood forest. *Ecological Applications*. 13: 98-118.
- Knopp, P.D., and M.J. Twery. 2006. NEDLite user's manual: forest inventory for Palm OS handhelds. General Technical Report NE-340. Newtown Square, PA: USDA Forest Service, Northeastern Research Station. 64p.
- Lancaster, K. F., and W. B. Leak. 1978. A silvicultural guide for white pine in the Northeast. Gen. Tech. Rept. NE-41. St. Paul, MN: USDA Forest Service, North Central Research Station. 13p.
- Leak, W.B., D.S. Solomon, and P.S. Debal. 1987. *Silvicultural Guide for Northern Hardwood Types in the Northeast* (revised). Research Paper NE-603. Broomall, PA: USDA Forest Service, Northeastern Forest Research Station. 36p.
- Roach, B.A., S.F. Gingrich. 1968. *Evenaged Silviculture for Upland Central Hardwoods*. Agriculture Handbook 355. Upper Darby, PA: USDA Forest Service, Northeastern Forest Experiment Station. 39p.
- Rossell, C.R., Jr., S. Patch, and S. Salmons. 2007. Effects of deer browsing on native and non-native vegetation in a mixed oak-beech forest on the Atlantic Coastal Plain. *Northeastern Naturalist*. 14: 61-72.
- Sampson, T.L., J.P. Barrett, and W.B. Leak. 1983. A Stocking Chart for Northern Red Oak in New England. New Hampshire Agricultural Experiment Station Research Report Number 100. 14p.
- Simpson, B.T., R.P. Kollasch, M.J. Twery, and T.M. Schuler. 1995. NED/SIPS User's manual – Northeast Decision Model Stand Inventory Processor and Simulator. Gen. Tech. Rpt. NE-205. Radnor, PA: USDA Forest Service, Northeastern Forest Experiment Station. 103p.



- Sperduto, D.D. 2000. Natural Communities Map of Great Bay National Wildlife Refuge. GIS Data, provided by US Fish and Wildlife Service.
- Sperduto, D.D., and W.F. Nichols. 2004. Natural Communities of New Hampshire. NH Natural Heritage Bureau, Concord, NH. Pub. UNH Cooperative Extension, Durham, NH. 229p.



## Appendix I

USFWS



*Stubbs Pond*

## Contaminants Review of the Peverly Brook Drainage Area

UNITED STATES GOVERNMENT  
MEMORANDUM

U.S. FISH AND WILDLIFE SERVICE  
NEW ENGLAND FIELD OFFICE  
70 COMMERCIAL STREET, SUITE 300  
CONCORD, NEW HAMPSHIRE 03301-5087

TO: Graham Taylor, Refuge Manager,  
Parker River National Wildlife Refuge

February 3, 2014

FROM: Thomas Chapman, Supervisor, New England Field Office

SUBJECT: Sampling Review

Attached as you requested is the contaminants review containing data collected as part of the clean-up of the former Pease Air Force Base. This review focuses on the Peverly Brook drainage area located at Great Bay National Wildlife Refuge. I understand that this review will be used as an appendix for the Great Bay Comprehensive Conservation Plan.

If you have any questions, please contact Mr. Drew Major of this office at 603-223-2541.

Attachment

## **Introduction**

This is a retrospective review of sampling plans and data compiled as part of the clean-up of the former Pease Air Force Base. This review focuses on the Peverly Brook drainage area located at Great Bay National Wildlife Refuge (maps I-1 and I-2). Below is a summary of the major points of each of the plans and data reports. Also included is a discussion section which describes key findings and trends, explains current sources of contamination, and suggests further sampling.

## **Summary of Important Points of Sampling Reports and Data**

### **Basewide Surface Water, Sediment, and Fish Tissue Monitoring (United States Air Force 1998)**

This report documents sample sites, analytes, and sampling frequency for monitoring. This document also states the cleanup goals and is a useful reference document for interpreting monitoring results.

### **Long-Term Monitoring Sampling and Analysis Plan (United States Air Force 1999)**

This plan details the field protocols that were used during the subsequent site monitoring and sample collection. It is also a useful reference document for interpreting monitoring results.

### **Draft Fieldwork Notification Biota Sampling: Pease Air Force Base (Watson 2001)**

This report details the objectives, methods, and analysis of the 2001 fish collection. It is also useful as a reference document for interpreting monitoring results.

### **Basewide Surface Water, Sediment, and Fish Tissue Monitoring (Bechtel 1999)**

This review is limited to drainage area G (Peverly Brook).

#### **Peverly Brook and Upper Peverly Pond**

- *Surface Water* - Surface water samples exceeded cleanup goals for arsenic (As), iron (Fe), and lead (Pb). Landfill-1 may be contributing metals to Upper Peverly Pond.
- *Sediment* - Sediment samples exceeded cleanup goals for arsenic, lead, nickel (Ni), and zinc (Zn). Time series plots indicate an increasing concentration trend in Upper Peverly Pond.

#### **Lower Peverly and Stubbs Pond**

- *Surface Water* - Surface water samples exceeded cleanup goals for arsenic.
- *Sediment* - All sediment samples met cleanup goals. Time series plots indicate an increasing concentration trend in Stubbs Pond and a decreasing trend in Lower Peverly Pond.

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No fish tissue monitoring was required for the time period covered by this report. Since pesticide/PCB (polychlorinated biphenyl) levels were low, the author recommended that water and sediment samples not be analyzed for these constituents in the future.

#### **Basewide Surface Water, Sediment, and Fish Tissue Monitoring (MWH Americas 2002)**

This review is limited to drainage area G (Peverly Brook).

#### **Peverly Brook and Upper Peverly Pond**

- *Surface Water* - Iron levels exceeded the cleanup goal at four different sampling stations between the years 1993-2001. In 2001, only the farthest upstream station exceeded the iron cleanup goal. Pesticide analysis was discontinued in 2000 because levels were below detection limits.
- *Sediment* - No sediment samples exceeded metals cleanup goals in 2001. The area around Station 8015 (center of Upper Peverly Pond) continues to act as a sediment and metals trap. Pesticides continue to be flushed out of the tributaries and are accumulating in the sediments of Upper Peverly Pond. There are no cleanup goals established for pesticides.

#### **Human and Ecological Health Risk**

No human health risk from ingestion of recreationally caught catfish and bass from Stubbs Pond. This is limited ecological risk to belted kingfisher from ingestion of fish from Stubbs Pond from arsenic and zinc.

#### **Fish**

The report compared the results of the 2001 sampling event to the 1996 sampling event. Fish were not sampled in Stubbs Pond in 2001 due to insufficient water levels. In Upper Peverly Pond, the highest concentrations of mercury (Hg) (0.42 ppm) and DDE (0.2 ppm) were found in largemouth bass, while the lowest (0.04 and 0.017 ppm respectively) were found in bluegill sunfish. The same relationships were true for Lower Peverly Pond, although the levels were approximately half that found in Upper Peverly Pond fish (i.e., 0.24 ppm mercury and 0.089 ppm DDE in largemouth bass).

The average mercury (Hg) concentrations found in largemouth bass filets were 0.318 ppm in Upper Peverly Pond and 0.226 ppm in Lower Peverly Pond. These levels are consistent with those found throughout the Region. The U.S. Environmental Protection Agency recommends limiting fish meals to no more than three per month when mercury levels are between 0.23 and 0.31 ppm.

Note: During the review of the document, the Department of the Interior, the U.S. Environmental Protection Agency (EPA), and the New Hampshire Department of Environmental Services (NHDES) requested that fish sampling be conducted in 2006 (especially in Stubbs Pond). The Air Force disagreed and stated "There is currently no requirement to sample in 2006



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*and neither the EPA nor the NHDES has articulated a clear objective for continued fish tissue sampling."* There has been no additional fish tissue sampling conducted by the Air Force since 2001.

#### **Stubbs Pond-Peverly Brook Drainage System (Vanasse Hangen Brustlin 2005)**

Stubbs Pond is located within Drainage Area G. The largest contributor of contaminants to the Peverly Brook drainage is Zone 2 which includes Landfill 1, Fire Department Training Area 1, Munitions Maintenance Area, Construction Rubble Dump, and the McIntyre Drum Disposal Area. Historic contaminants of concern in the drainage include metals (aluminum [Al], arsenic, iron, lead, manganese [Mn], nickel, and zinc) and pesticides (DDT and metabolites). Landfill 1 was primarily responsible for the metals while historic base-wide use of DDT was responsible for the pesticide levels.

Nineteen sediment samples were collected in December 2004 and submitted for analysis. Chromium (Cr) levels from one sample (SP-10A in the center of the pond) exceeded the probable effect concentration (PEC) as defined by McDonald *et al.* (2000). PEC values are screening thresholds above which adverse effects are likely. When results were compared to NOAA's Screening Quick Reference Tables, arsenic, cadmium (Cd), chromium, nickel, lead, and zinc exceeded the Effects Range-Low in at least one sample, but no samples exceeded the Effects Range-Medium. Concentrations between the Effects Range-Low and Effects Range-Medium are occasionally associated with adverse effects.

#### **Discussion**

Upper Peverly Pond has acted as a sediment and heavy metal trap, preventing the majority of the contaminants from migrating farther down the watershed. However, some metals have migrated from Upper Peverly Pond, through the system, and have been deposited into the low flow velocity area of Stubbs Pond. Landfill 1 is the primary source of the metals. The metal levels in Stubbs Pond are relatively low with the exception of sampling sites in the middle of the pond. There was a decline in sediment metal levels in Upper Peverly Pond between 1999-2000. This trend may be continuing as clean sediment has been deposited on top of the contaminated sediment. It would be prudent to resample Upper Peverly Pond sediments to confirm that Landfill 1 is no longer depositing metals into the pond. During any resampling, at least one sample should be taken from the deepest spot in the pond in order to ensure representative sampling.

Levels of mercury and DDE in largemouth bass from Upper Peverly Pond are elevated in relation to the other waterbodies of the Peverly Brook drainage area. Although the level of mercury in largemouth bass (mean of 0.32 ppm) appears to pose a limited risk to piscivorous birds, it is important to note that the size of the bass sampled in Upper Peverly Pond was selected to estimate the risk to human health and not ecological health. In order to properly estimate the risk to piscivorous species that would be expected to use Upper Peverly Pond (such as belted kingfisher, osprey, and bald eagle), sampling of more appropriate size classes would be required. High levels of DDE in feed (10 ppm) can also result in eggshell thinning and have other



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reproductive effects in waterfowl. However, it does not appear that DDE levels in Upper Peverly Pond are high enough pose a risk to waterfowl and other piscivorous wildlife.

In addition to existing contaminants from operations at the former Pease Air Force Base, the adjacent Pease International Tradeport is a possible continuing source of contaminants to the Peverly Brook drainage area. These contaminants may include herbicides and de-icing material (propylene glycol). Given the correct equipment and appropriate funding, these contaminants can be detected and monitored.

At the request of the Great Bay Refuge, the New England Field Office can draft a contaminants monitoring plan for the Peverly Brook drainage area. The plan would outline a three-year on-refuge study to monitor water quality and contaminant levels in sediments and fish tissue, as well as to track any changes and trends in contamination levels. However, due to the high cost of contamination monitoring, it may be difficult to guarantee a funding source for the plan's implementation. Potential funding sources would need to be identified and pursued.

## Documents Reviewed

The following documents are on file at Great Bay Refuge Headquarters.

### Reference Documents

United States Air Force. 1998. Pease Air Force Base Basewide Surface Water, Sediment, and Fish Tissue Monitoring: Long-term Monitoring Plan *prepared by* Bechtel Environmental, Inc. *for* Air Force Base Conversion Agency and Air Force Center for Environmental Excellence, Base Closure Division. April 1998.

United States Air Force. 1999. Pease Air Force Base: Long-Term Monitoring Sampling and Analysis Plan *prepared by* Bechtel Environmental, Inc. *for* Headquarters Air Force Base Conversion Agency and Air Force Center for Environmental Excellence, Base Closure Division. January 1999.

MacDonald D.D., C.G. Ingersoll and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch. Environ. Contam. Toxicol.* 39:20-31.

Montgomery Watson. 2001. Draft Fieldwork Notification Biota Sampling: Pease AFB, Portsmouth, N.H. *prepared by* Montgomery Watson *for* Air Force Center for Environmental Excellence, Environmental Restoration Division. August 2001.

### Sampling Results

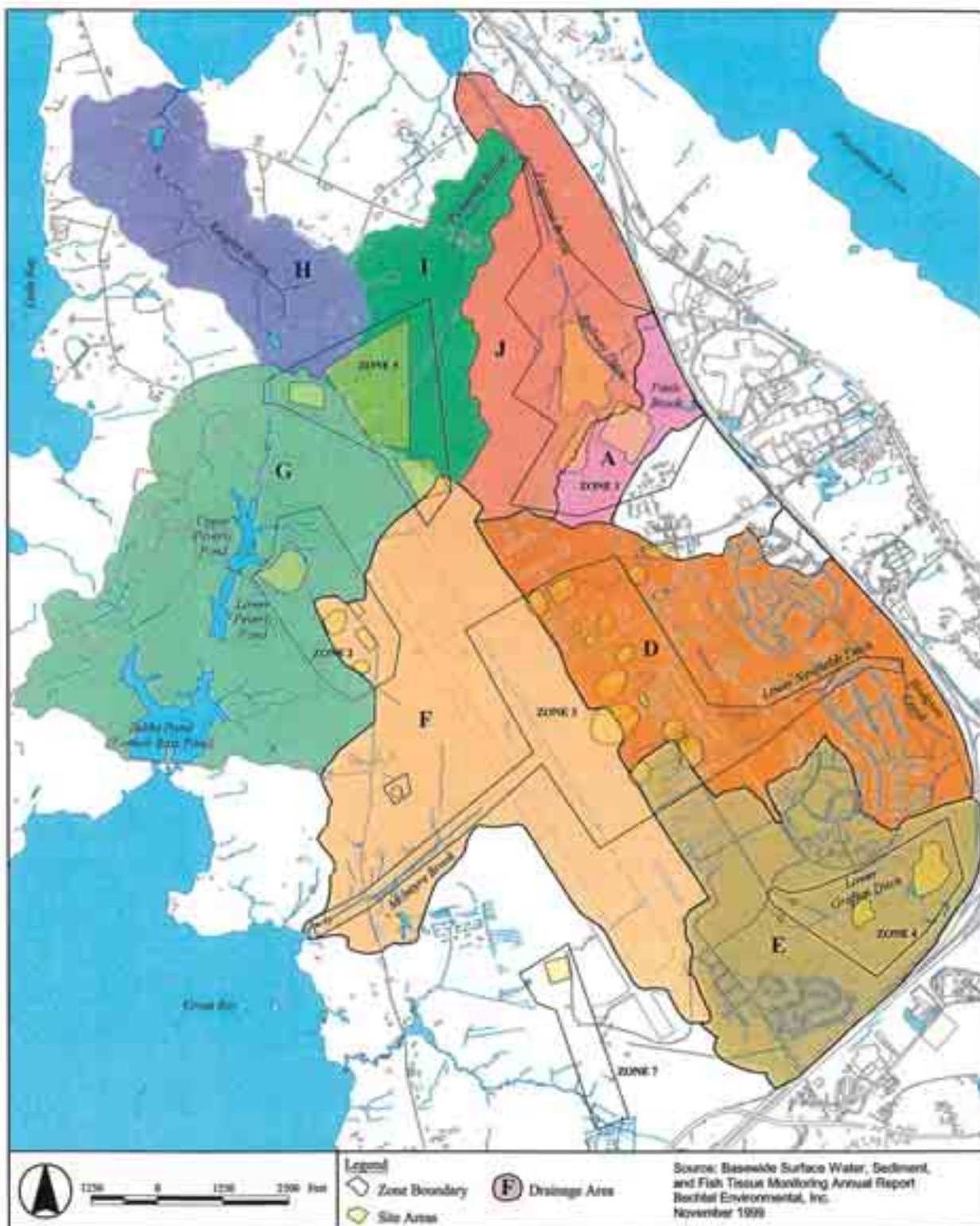
Bechtel Environmental, Inc. 1999. Pease Air Force Base: Basewide Surface Water, Sediment, and Fish Tissue Monitoring Annual Report *prepared by* Bechtel Environmental, Inc. *for* Air Force Base Conversion Agency and Air Force Center for Environmental Excellence, Base Closure Division. November 1999.

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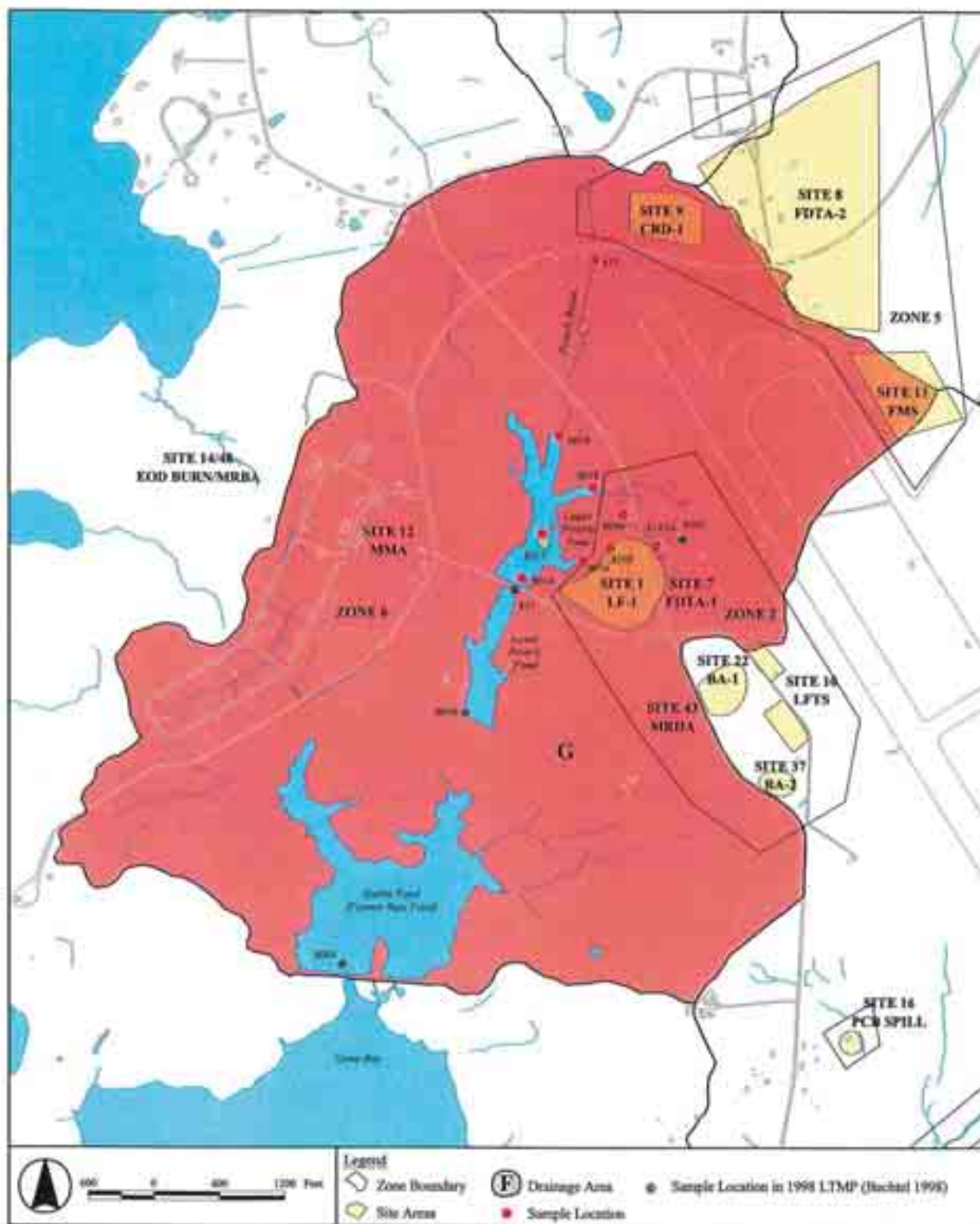
MWH Americas, Inc. 2002. Basewide Surface Water, Sediment, and Fish Tissue Monitoring, Pease AFB, Portsmouth, N.H. *prepared by* MWH Americas, Inc. *for* Air Force Center for Environmental Excellence, Environmental Restoration Division. June 2002.

Vanasse Hangen Brustlin, Inc. 2005. Stubbs Pond-Peverly Brook Drainage System (Formerly Known as Bass Pond), Great Bay National Wildlife Refuge, Newington, New Hampshire *prepared by* Vanasse Hangen Brustlin, Inc. *for* Department of Environmental Services, New Hampshire Coastal Program.



**Figure 1-2**  
**Drainage Areas and Associated Sites**  
**Pease Air Force Base, New Hampshire**





## Appendix J



*Great Bay Refuge welcome sign*

## Great Bay National Wildlife Refuge Headquarters/Visitor Contact Station



**Refuge Headquarters/  
Visitor Contact Station**

This appendix provides additional information on the new refuge headquarters/visitor contact station building proposed under this CCP. The facility would be approximately 7,000-square feet. We would construct it in an area already disturbed as part of the former Weapons Storage Area (map J.1). Figure J.1 is a conceptual drawing representing the Service's standard one-story, small administrative building and visitor contact station. Figure J.2 shows a generic floor plan for this standard building. We have included the drawing and floor plan for general reference only and they do not necessarily represent the exact building facade or room configuration that would be part of the design for Great Bay National Wildlife Refuge.

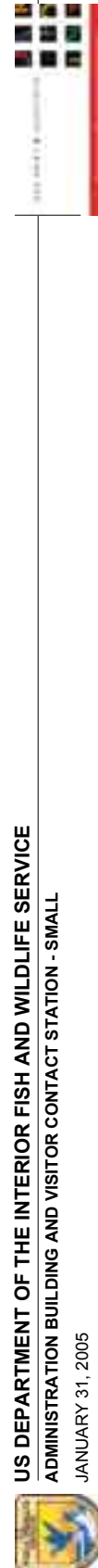
Map J.1 Location of Proposed Refuge Headquarters/Visitor Contact Station



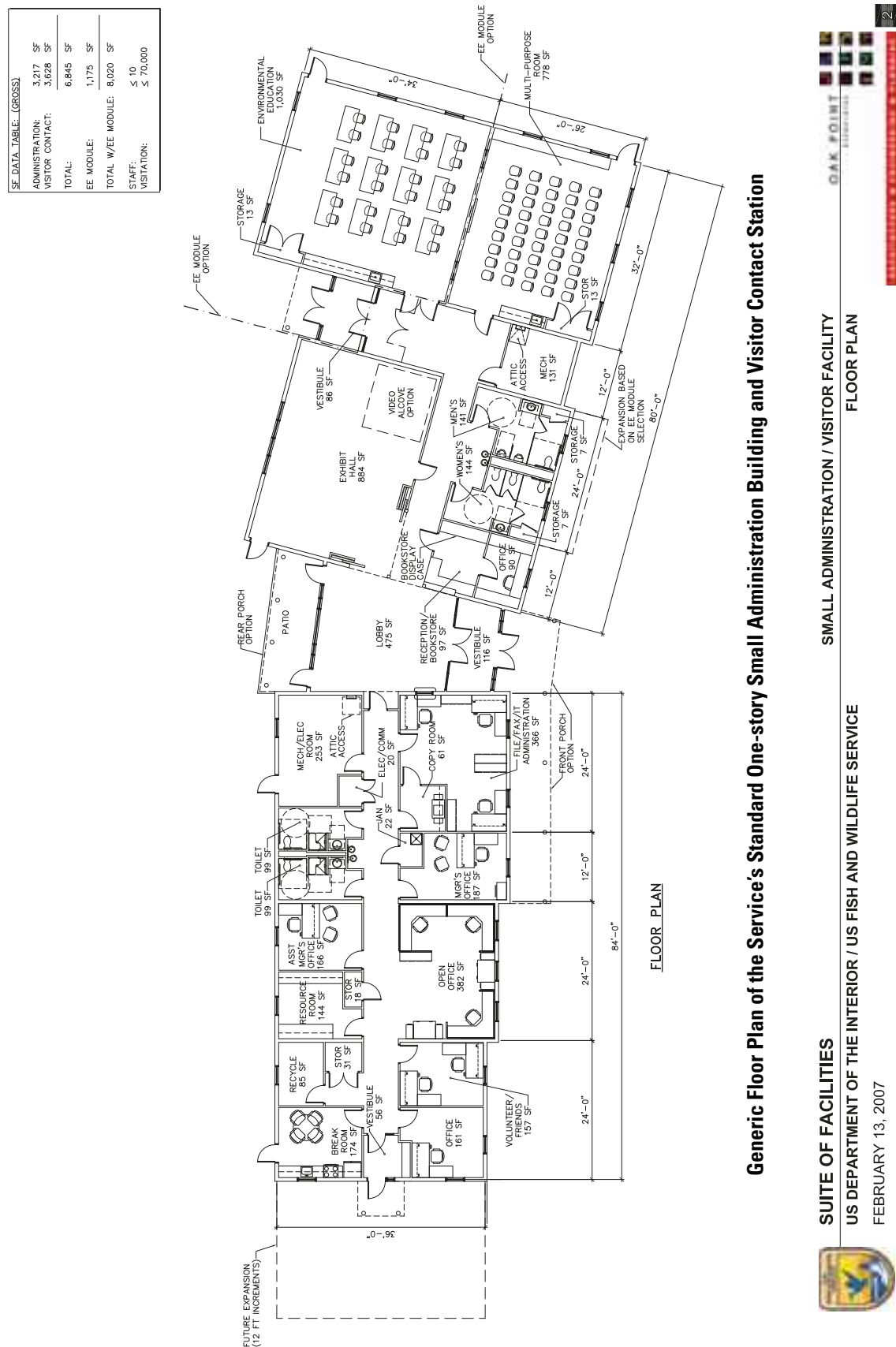
Figure J.1. Conceptualization of the Service's Standard One-story Small Administration Building and Visitor Contact Station.



Conceptualization of the Service's Standard One-story Small Administration Building and Visitor Contact Station



**Figure J.2. Generic Floor Plan of Service Standard One-story Small Administration Building and Visitor Contact Station**





## Appendix K



*Comment from 7 year old attending a public meeting*

# Summary of Public Comments and Service Responses on the Draft Comprehensive Conservation Plan and Environmental Assessment for Great Bay National Wildlife Refuge and the Karner Blue Butterfly Conservation Easement



## Introduction

In February 2012, the U.S. Fish and Wildlife Service (Service, we, our) completed the draft Comprehensive Conservation Plan and Environmental Assessment (draft CCP/EA) for Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge), including the Karner blue butterfly conservation easement (conservation easement). The draft CCP/EA outlines three alternatives for managing the refuge. Alternative B is identified as the “Service-preferred alternative.”

We released the draft CCP/EA for 39 days of public review and comment from February 10 to March 19, 2012. We also held a public meeting in Newington, New Hampshire, on March 8, 2012, that was attended by 27 people. We evaluated all the letters and e-mails sent to us during that comment period, along with comments recorded at our public meeting. This document summarizes all of the substantive comments we received and provides our responses to them.

Based on our analysis in the draft CCP/EA and our evaluation of comments received on that document, we modified the Service-preferred alternative (alternative B) as originally presented in the draft CCP/EA and recommend this modified version to our Regional Director for implementation as the final CCP. It includes minor modifications to the management actions outlined under alternative B in the draft CCP/EA. We have determined that none of these changes warrants our publishing a revised or amended draft CCP/EA before submitting the final CCP to our Regional Director for approval.

Below we highlight some of the modifications we made in the final CCP.

1. We added a strategy under Objective 2.3, “Upland Shrubland” in the final CCP. In the draft CCP/EA under Objective 2.1, “Appalachian Oak-Hickory Forests,” we proposed to allow 41 acres of grassland and shrubland habitat to naturally transition to forest. Based on comments from New Hampshire Fish and Game (NHFG), we have decided to slightly modify this. In the final CCP, we still plan to allow these areas to naturally transition; however, we added an additional strategy that states, “Within 5 years, evaluate wildlife use and response in the 41 acres of grassland and shrubland we are allowing to naturally transition to forest (see objective 2.1). If these areas are providing regionally important habitat to shrubland-dependent species of conservation concern, evaluate whether the resources are available to actively manage these areas as shrubland, and adjust management accordingly, rather than allowing them to continue to transition to forest.”
2. We added a strategy under Objective 1.3, “Freshwater Impoundments and Peverly Brook System,” in the final CCP. Based on comments from NHFG, we have added the following strategy regarding sediment contamination: “Within 3 years of CCP approval, work with partners to detect and remove “hot spots” of DDT contamination in Upper Peverly Pond, if determined feasible, and contingent upon funding and staffing.”
3. We amended our existing strategy on evaluating the effectiveness of the Stubbs Pond fish ladder under Objective 1.3, “Freshwater Impoundments and Peverly Brook System,” in the final CCP. Based on comments from NHFG, we added the following language to the existing strategy, “If this evaluation recommends that the fish ladder be updated or repaired, we will implement those recommendations within 3 years of the review, or as soon as funding allows.”
4. We revised one of the strategies under Objective 2.2, “Forested and Scrub-Shrub Wetlands” to address a concern that New Hampshire Natural Heritage Bureau (NHB) had about protecting rare plant communities. Our new strategy states: “Inventory, map, and assess the quality of forested and scrub-shrub wetlands, including vernal pool habitat, rare plants, and rare natural communities. Identify actions that will sustain or enhance these areas, including treating invasive plants, as warranted.”

Our Regional Director will select one of the following for our final CCP:

- Our modified alternative B.
- One of the other alternatives analyzed in the draft CCP/EA.
- A combination of actions from among the alternatives analyzed in the draft CCP/EA.

The Regional Director will also determine whether a Finding of No Significant Impact (FONSI) is justified prior to finalizing the decision. The decision will be made after:

- Reviewing all the comments received on the draft CCP/EA, and our responses to those comments.
- Affirming that the CCP actions:
  - \* Support the purpose and need for the CCP.
  - \* Support the purposes for which the refuges were established.
  - \* Help fulfill the mission of the National Wildlife Refuge System.
  - \* Comply with all legal and policy mandates.
  - \* Work to best achieve each refuge's vision and goals.

At the same time we release an approved final CCP, we will publish a notice of the availability in the *Federal Register*. That notice will complete the planning phase of the CCP process, and we can begin implementing the plan.

## **Summary of Comments Received**

After the comment period ended on March 19, 2012, we compiled all of the comments we received, including all letters, e-mails, and comments recorded at public meetings. In total, we received 25 written responses. The responses we received represent 23 different signatures and 78 individual comments.

We received a variety of letters from local, State, and Federal governmental agencies, including the following:

- New Hampshire Department of Environmental Services–New Hampshire Coastal Program (NHCP)
- New Hampshire Division of Historic Resources (NDHR)
- New Hampshire Fish and Game Department (NHFG)
- New Hampshire Natural Heritage Bureau (NHB)
- Town of Newington, New Hampshire, Conservation Commission
- U.S. Environmental Protection Agency (EPA)

We also received comments signed by representatives from the following conservation organizations:

- Defenders of Wildlife
- Great Bay Resource Protection Partnership (GBRPP)
- Piscataqua Region Estuaries Partnership (PREP)
- Society for the Protection of New Hampshire Forests (SPNH)
- The Nature Conservancy (TNC)

In the discussions below, we address and respond to every substantive comment we received. Substantive comments are those that suggest our analysis is flawed in a specific way. Generally, substantive comments meet at least one of the following criteria:

- Challenge the accuracy of information presented.
- Challenge the adequacy, methodology, or assumptions of the environmental or social analysis and supporting rationale.
- Present new information relevant to the analysis.
- Present reasonable alternatives, including mitigation, other than those presented in the document.

Our discussion does not include responses to any comments we felt were non-substantive. For example, there were people who wrote us to thank us for hosting the public meetings, tell us that they thought the document was well written, or request copies of the draft CCP/EA on CD-ROM.

In order to facilitate our responses, we grouped similar comments together and organized them by subject heading. Directly beneath each subject heading, you will also see a list of unique letter identification (ID) numbers. Table K.1 at the end of this appendix relates each letter ID number to the name of the individual, agency, or organization that submitted the comment.

In several instances, we refer to specific text in the draft CCP/EA and indicate how the final CCP was changed in response to comments. The full versions of both the draft CCP/EA and the final CCP are available online at: <http://www.fws.gov/northeast/planning/Great%20bay/ccphome.html> (accessed May 2012). For a CD-ROM or a print copy, please contact staff at Parker River National Wildlife Refuge:

Parker River National Wildlife Refuge  
6 Plum Island Turnpike  
Newburyport, MA 01950  
Phone: 978/465 5753  
Email: [fw5rw\\_prnwr@fws.gov](mailto:fw5rw_prnwr@fws.gov)

## Service Responses to Comments by Subject

### Purpose and Need

#### Document - Specific

(Letter ID#: 1, 3, 23, and 25)

*Comment:* We received several comments pointing out typographical, formatting, and grammatical errors.

*Response:* We fixed all of the typographical, formatting, and grammatical errors that were pointed out to us. We also noticed an error we made in chapter 3 of the draft CCP/EA under the heading, “Actions Common to All of the Alternatives.” On page 3-4 of the draft CCP/EA we listed actions common to all of the alternatives that we planned to discuss in further detail. Although this list included “Conducting wilderness and wild and scenic river reviews,” we failed to direct readers to the review that we conducted. Our wilderness review for Great Bay Refuge is included as appendix D in both the draft CCP/EA and final CCP. We found that the refuge did not meet any of the minimum criteria for wilderness, and therefore does not qualify for wilderness designation. We did not conduct a wild and scenic river review for Great Bay Refuge because no river or river segment occurs on the refuge. We apologize for any confusion this may have caused.

*Comment:* EPA commented that map 1.1 in the draft CCP/EA was difficult to read and that the legend for map 1.2 was incomplete.

*Response:* We updated both of the maps to be more clear. In particular, we made it easier to distinguish between the different conservation protection categories on map 1.1 and updated the legend on map 1.2 to ensure it explained all of the symbols and lines used on the map.

*Comment:* PREP suggested that we acknowledge their 2010 Comprehensive Conservation and Management Plan in our CCP. In particular, they asked us to mention restoration objective 1.10 from their plan: “Restore or enhance an additional 300 acres of salt marsh by 2020 through removal of tidal restrictions or invasive species management.” They suggested that the refuge could support this objective through the following actions:

- Restoring salt marsh sparrows to unoccupied sites.
- Removing nonessential dams on coastal rivers and streams, including Stubbs Pond Dam.
- Restoring and enhancing salt marsh habitat.

*Response:* We list PREP's 2010 Comprehensive Conservation and Management Plan as one of many regional conservation plans we consulted during the development of the CCP in the section on "National and Regional Plans and Conservation Initiatives" in chapter 1 of both the draft CCP/EA and final CCP. We agree that the restoration and enhancement of salt marsh habitat is an important component of their plan and a vital resource in the Great Bay Estuary. Our only difference of opinion is their interest in our removing Stubbs Pond Dam and attempting to restore the area to salt marsh. We respond to that comment below under "Freshwater Impoundments–Stubbs Pond." Otherwise, we feel that our proposed actions in the final CCP will help enhance the refuge's 36 acres of salt marsh habitat and support objective 1.10 in PREP's plan. We list these actions as strategies and monitoring under Objective 1.1, "Salt Marsh," in chapter 4 of the final CCP. Specifically, we will:

- Develop an index of ecological integrity for the refuge's salt marsh, measure baseline conditions, and manage the refuge's salt marsh to ensure that there is no degradation of ecological integrity.
- Monitor and control invasive species in the refuge's salt marsh.
- Work with partners to conduct research on, and surveys of, salt marsh sparrows in Great Bay Estuary; and
- Prohibit public access to the refuge's salt marsh habitat and provide information to refuge visitors about the importance of salt marsh to the health of Great Bay Estuary.

*Comment:* EPA felt our description of why the proposed action required an EA was unclear in chapter 1 of the draft CCP/EA.

*Response:* Service policy (602 FW 3.4(B)) requires that an EA or Environmental Impact Statement accompany, or be integrated into, each CCP. We discuss this under the section, "Refuge Planning and Management Guidance," in chapter 1 of both the draft CCP/EA and final CCP.

*Comment:* NHCP, NHFG, and EPA commented on several inconsistencies in the draft CCP/EA.

1. First, there was an apparent contradiction about the potential impacts of climate change on Stubbs Pond. On page 3-43 of the draft CCP/EA, we state, "A recent study commissioned by the Service reported that Stubbs Pond is unlikely to be affected by sea level rise as a result of climate change (Clough and Larson 2009), although more detailed analysis is needed." However, on page 4-43 we state, "The area of the refuge most at risk from sea level rise is Stubbs Pond."
2. Second, we list different costs for the removal of Lower Peverly Pond Dam and restoration of the area to stream habitat in two tables in Appendix E, "Refuge Operation Needs System (RONS) and Service Asset Maintenance Management System (SAMMS) Projects" of the draft CCP/EA. In table E.2, "Projects Proposed for the RONS Database for Great Bay Refuge under alternative B," we list an estimated one-time cost of \$200,000 and a recurring base cost of \$20,000. However, in table E.4, "Current Projects in the SAMMS Database for Great Bay Refuge," we list the cost as \$500,000.
3. Third, NHFG and NHCP felt we were inconsistent about the months in which the fish passage at Stubbs Pond is in operation on pages 2-30, 3-42, and 3-44 of the draft CCP/EA.
4. Fourth, NHFG noted that we used the terms blueback herring, alewife, and river herring inconsistently and noted that river herring is an umbrella term for both alewife and blueback herring.
5. Fifth, the EPA pointed out that we did not use consistent terminology to describe the process we followed to analyze environmental consequences in chapter 4 of the draft CCP/EA. In particular, they suggested that we change the phrase "cumulative influences of effects" with either "cumulative effects" or "cumulative impacts."

*Response:*

1. The two apparently conflicting statements about the impacts of climate change on Stubbs Pond are actually referring to different time scales. The statement on page 3-43 refers to potential short-term climate change impacts, while the statement on page 4-43 refers to anticipated longer-term impacts. To clarify, the point we are trying to make is that over the 15-year time span covered by the CCP, it is unlikely that Stubbs Pond will be measurably affected by climate change, but that over the long term, Stubbs Pond may be vulnerable to climate change and associated impacts. We understand why this may have been confusing to readers. In chapter 4 of the final CCP, we updated our rationale for Objective 1.3, “Freshwater Impoundments and Peverly Brook System,” to be clear that we do not anticipate climate change impacts to Stubbs Pond over the 15-year timeframe of the CCP.
2. The RONS database and SAMMS database each address different aspects of refuge management and operations. The \$500,000 cost listed in the SAMMS database (table E.4) refers to the estimated cost to remove the Lower Peverly Dam. The one-time \$200,000 and recurring \$20,000 costs listed in the RONS database (table E.2) refer to the costs related to planning and monitoring the dam removal and habitat restoration. We updated tables E.2 and E.4 in appendix E of the final CCP to make this distinction more obvious.
3. The descriptions of the fish ladder on pages 2-30, 3-42, and 3-44 of the draft CCP/EA all refer to different things:
  - Page 2-30 refers to how we have historically managed the fish ladder (late April to early July).
  - Page 3-42 describes how we propose to manage the fish ladder under alternative B of the draft CCP/EA (late April to mid-July).
  - Page 3-44 identifies that volunteers have observed blueback herring actually using the fish ladder during the month of May.

However, we understand why this may have been confusing to readers. We have updated our discussions of the fish ladder under the section on “Freshwater Impoundments– Stubbs Pond (Recent Management),” in chapter 3, and in the rationale Objective 1.3, “Freshwater Impoundments and Peverly Brook System,” in chapter 4, of the final CCP to make a clearer distinction.
4. We have decided to not use the umbrella term “river herring” in our final CCP. Instead, we have used the terms “blueback herring” and “alewife” throughout the final CCP to reduce confusion.
5. We agree that we could have been more consistent in our terminology about describing the process we used to analyze environmental impacts. We will make note of this for future documents that need to comply with the National Environmental Policy Act of 1969 (NEPA). However, we do not feel that this suggested modification would result in a substantive change to the analysis we conducted in chapter 4 of the draft CCP/EA, and therefore, do not feel a revised EA is warranted.

**Alternatives****General***(Letter ID#: 13 and 19)*

*Comment:* NHB felt “comfortable” with either alternative B or alternative C because both included strategies to help conserve rare plants and natural communities. Another respondent “found it difficult to commit to one [alternative] 100 [percent],” but did not provide any specific reasons.



*Response:* We thank NHB and the other individual for their comments on our draft alternatives. Our final CCP includes all of the strategies to conserve rare plants and natural communities under alternative B of the draft CCP/EA. Please see our response below under “Rare Plants and Natural Communities” for more information on our management for these resources.

**Alternative B- Habitat Diversity and Focal Species Emphasis (Service-preferred Alternative)**

*(Letter ID#: 7, 9, 10, 11, 12, 15, 16, 20, and 25)*

*Comment:* The town of Newington Conservation Commission, SPNHF, GBRPP, TNC, NHFG, and three individuals supported the Service-preferred alternative B. Respondents specifically mentioned the following reasons for supporting alternative B:

- Actively managing to provide diverse habitats to support a range of native plant and wildlife species, especially those of conservation concern
- Helping to protect rare, threatened, and endangered species such as upland sandpiper (State endangered), Karner blue butterfly (federally endangered), and New England cottontail (Federal candidate species)
- Expanding public access and enhanced wildlife-dependent recreational opportunities, including evaluating expanding the refuge’s hunting program to include turkey hunting and a fall archery deer hunt
- Balancing recreational opportunities with maintaining ecological integrity
- Removing Lower Peverly Pond Dam and restoring the area to stream habitat to improve fish passage and restore natural flow processes
- Restoring estuarine habitats, including oyster reefs and eelgrass beds
- Working with partners to achieve conservation goals
- Committing to science-based conservation
- Controlling invasive species
- Restoring habitat and creating hibernacula for native bat species

*Response:* We appreciate the level of support for our preferred alternative. We have recommended alternative B from the draft CCP/EA for implementation, including all of the actions mentioned in these comments. Chapter 4 in the final CCP details our proposed management direction.

**Global Climate Change**

**General**

*(Letter ID#: 1 and 18)*

*Comment:* NHCP asked us to, “discuss the additional analysis the Service will conduct to further its understanding of the potential impacts of climate change on the refuge, and more specifically, Stubbs Pond.”

*Response:* We expect to increase our understanding of existing baseline conditions and potential impacts of climate change through increased monitoring. In chapter 4 of the final CCP, we identify strategies and monitoring activities related to climate change under the following objectives: Objective 1.1, “Salt Marsh,” Objective 1.2, “Intertidal and Shallow Estuarine Waters,” Objective 1.3, “Freshwater Impoundments and Peverly Brook System,” Objective 2.1, “Appalachian Oak-Hickory Forests,” and Objective 3.2, “Landscape-scale Conservation Partnerships.”

*Comment:* Defenders of Wildlife provided us with a set of criteria they developed to help evaluate how well CCPs incorporate climate change considerations.

*Response:* We thank Defenders of Wildlife for providing the climate change criteria. We used the document to review our draft CCP/EA and feel that we adequately addressed climate change. We also look forward to using the criteria to help improve our climate change analysis in future CCPs.

## **Refuge Administration**

### **Staffing**

(Letter ID#: 6, 15, and 25)

*Comment:* We received three comments on staffing. GBRPP and NHFG supported our proposal under alternative B for four new positions stationed at Great Bay Refuge. NHFG specifically stated that, “To achieve the vision and goals for [the refuge] presented in Alternative B of the draft CCP, the refuge needs its own staff on station.” Another individual felt that at least one staff member needs to be stationed at the refuge.

*Response:* We appreciate the support for our proposed staffing for Great Bay Refuge. We feel the positions we proposed in the Appendix F, “Staffing Chart,” of the draft CCP/EA would be instrumental in achieving our vision, goals, and objectives for the refuge. We are hopeful that Great Bay Refuge will eventually have its own staff stationed on the refuge. However, we are also realistic about the current economic and Federal budget situation and realize that this may not happen in the near term. As we note on the inside cover of the draft CCP/EA and final CCP, this document does not constitute a commitment for increases in staffing and budget. Rather, CCPs provide long-term, strategic guidance and describe the desired, future conditions for the refuge.

### **Facilities**

(Letter ID#: 11, 15, and 17)

*Comment:* We received three comments on refuge facilities. One individual supported our proposal to remove unnecessary buildings and facilities on the refuge because “they serve no purpose and are too difficult to maintain.” The GBRPP supported our proposal to build a new refuge headquarters to support our proposed staff increase. Another individual enthusiastically supported a visitor contact facility.

*Response:* We appreciate the level of support for our proposed visitor contact station/refuge headquarters and removal of unnecessary buildings and facilities in the former Weapons Storage Area and on Fabyan Point, pending evaluations by the State Historic Preservation Officer (SHPO). Our proposals were discussed in chapter 3 of the draft CCP/EA on pages 3-10, 3-12, and 3-16 and are included in the final CCP, chapter 4, under the sections on “Refuge Staffing, Facilities, and Administration” and “Protecting Cultural Resources.”

### **Partnerships**

(Letter ID#: 23)

*Comment:* EPA requested that we include additional information on PREP, including that it is one of 28 federally recognized estuary programs and focuses on Great Bay, Little Bay, and the Hampton/Seabrook areas. They also asked us to elaborate on how the partners listed on page 4-9 of the draft CCP/EA tie into the work that the refuge is doing to improve the health of the Great Bay Estuary watershed.

*Response:* We thank EPA for their suggestions. We have used this information to update our section on “Piscataqua Region Estuaries Partnership’s Comprehensive Conservation and Management Plan” in chapter 1 of the final CCP. We discuss these partnerships elsewhere in both the draft CCP/EA and final CCP. In the final CCP, we provide descriptions of our partners and the conservation work they do in the Great Bay Estuary in chapter 1 under the section on “National and Regional Plans and Conservation Initiatives” and in chapter 3 under the section on “Key Refuge Partnerships.” We also list the specific strategies and monitoring actions we will take with these partners under each of the objectives in chapter 4 of the final CCP.

### **Refuge Expansion and Land Acquisition**

(Letter ID#: 4, 12, 16, and 25)

*Comment:* We received three comments in support of our proposal to further evaluate land protection focus areas. In particular, respondents supported efforts to protect additional habitat for the federally endangered Karner blue butterfly and the New England cottontail, a Federal candidate species. One individual further proposed that the Service create a “[Karner Blue Butterfly] National Wildlife Refuge.”

Both TNC and NHHF urged us to consider conducting our evaluation of focus areas sooner than proposed in the plan (within 5 years of CCP approval). NHHF felt that the proposed focus areas, particularly the Dover Focus Areas and Rollinsford Focus Areas, are “vulnerable to land use change and development” and that “the timing presented in the draft may be too slow to prevent loss of these critical New England cottontail habitats.”

*Response:* We appreciate the level of support for our proposal to further evaluate the land protection focus areas we identified in chapter 3 of the draft CCP/EA. In that evaluation, we will consider each area’s resource values, both from a regional and local perspective, and threats to those values, including development and other land use changes. Our plans are to complete this evaluation within 5 years; however, it could possibly be done sooner with partner support and additional staffing and funding. If our analysis determines that land protection by the Service should be pursued, we would seek approval from our Director to prepare a separate EA and Land Protection Plan at that time. For additional information about our proposal, please see the section on “Land Protection Focus Areas” in chapter 4 of the final CCP. We will also continue to work with other Service program staff and partners, who are evaluating conservation needs for New England cottontail across the region.

*Comment:* SPNHF was disappointed that the draft CCP/EA did not address the Service’s role in conserving the Hampton Salt Marsh estuarine system. They felt that the area is not currently conserved in a “coordinated manner” because of “highly fragmented ownership patterns.” They also stated that they own a number of parcels in the Hampton Salt Marsh area and “expressed a willingness to deed them to the Service should the expansion of either [Great Bay or Parker River Refuge] be possible.”

*Response:* We agree that the Hampton-Seabrook-Salsbury Marsh area is an important salt marsh community and is threatened by development and fragmentation. In chapter 3 of the draft CCP/EA (page 3-16), we describe this area as a land protection focus area for the refuge. Please see our previous response for more information on future land protection.

## **Physical Resources**

### **Air Quality**

(Letter ID#: 23)

*Comment:* EPA requested that we explain in greater detail in our air quality discussion that the town of Newington, New Hampshire, is “one of the most commercialized in the seacoast.” They also asked if we conducted any special management activities to maintain air quality because of the surrounding commercial development.

*Response:* Based on this comment, we added a sentence that the region around the refuge is heavily commercialized in the section on “Air Quality” in chapter 3 of the final CCP. We do not currently conduct any special air quality management activities, but we do try to limit the amount of emissions caused by our management on the refuge. The section on “Climate Change” in chapter 4 of the final CCP lists our strategies for reducing our greenhouse gas emissions.

### **Water Quality and Sediment Contamination**

*(Letter ID#: 25)*

*Comment:* NHFG commented on water and sediment contamination. First, they recommended that we conduct our proposed assessment of water and sediment contamination in Lower Peverly Pond (Objective 1.3, page 3-91 of draft CCP/EA) sooner than “within 5 years of CCP approval.” They felt it was important for us to complete the assessment as soon as possible because the information would be needed for the permitting process to remove Lower Peverly Pond Dam. Second, they suggested that we look for “hot spots” of DDT, DDD, and DDE contamination in the sediments of Upper Peverly Pond. It was their understanding that DDT bioaccumulates in aquatic environments by attaching to sediments, but does not bioaccumulate in terrestrial environments. They felt we could reduce the risk of bioaccumulation in fish and birds by removing the contaminated sediments from the pond and storing them in a confined area on land.

*Response:* We agree that it would be best to start our assessment of water and sediment contamination in Lower Peverly Pond as soon as possible. However, the timing of this assessment will principally be driven by our ability to secure funding for it. We also greatly appreciate the suggestion to look for “hot spots” of DDT contamination. We have added this as a strategy under Objective 1.3, “Freshwater Impoundments and Peverly Brook System,” in chapter 4 of the final CCP. The timing and successful completion of this strategy will also depend upon successfully securing funding and staffing to implement it.

### **Biological Resources**

#### **Estuarine Habitats**

*(Letter ID#: 16)*

*Comment:* TNC was very supportive of our proposal under alternative B in the draft CCP/EA to help conserve and restore estuarine habitats in Great Bay, including salt marsh, oyster reefs, and eelgrass bed. They wrote, “We hope refuge staff will play an active role with...key partners to accelerate [the restoration]...of Great Bay’s fragile ecosystem.” Although they recognized that the refuge’s initial focus would be on Nannie Island, Woodman Point, and Herods Cove, they hoped that in the future the refuge would be able to “participate in restoration activities throughout Great Bay Estuary.”

*Response:* We appreciate TNC’s support of our proposal to conserve estuarine habitats. We look forward to pursuing partnerships to collaborate on priority projects in these important habitats. We describe the actions we plan to take to conserve these habitats under the section on “Protecting the Rocky Shore” and under Objective 1.2 “Intertidal and Shallow Estuarine Waters,” in chapter 4 of the final CCP.

*Comment:* PREP requested that we add salt marsh habitat to our list of emphasized habitats, and that we recognize salt marsh sparrows as a focal species.

*Response:* We agree that salt marsh is an important habitat in Great Bay Estuary and supports breeding salt marsh sparrows, as well as wintering waterfowl, foraging wading birds, fish, shellfish, and rare plants. We emphasize the importance of this habitat under Objective 1.1, “Salt Marsh” in both the draft CCP/EA and final CCP. In chapter 4 of the final CCP, under Objective 1.1, “Salt Marsh,” we list our strategies to help conserve this habitat. We also include several specific strategies related to salt marsh sparrow conservation, including conducting surveys of, and research on, salt marsh sparrows.

### **Stream Habitat Restoration – Removal of Lower Peverly Pond Dam**

(Letter ID#: 16, 25)

*Comment:* NHFG and TNC support our proposal under alternative B in the draft CCP/EA to remove Lower Peverly Pond Dam and restore the stream channel. However, NHFG urged us “to initiate planning, design, and permitting of this project as soon as possible “to ensure a “reasonable chance” that the project will be completed within 5 years of CCP approval.” They also offered to assist the refuge “in achieving a successful outcome for this project.”

*Response:* We appreciate the support for our proposal to remove Lower Peverly Pond Dam and look forward to working with partners to complete this project. We will begin the planning, design, and permitting of this project as soon as staffing and funding allow, which we hope will occur within the next few years. For more information on our proposed removal of Lower Peverly Pond Dam, please see Objective 1.3, “Freshwater Impoundments and Peverly Brook System” in chapter 4 of the final CCP.

### **Freshwater Impoundments—Stubbs Pond**

(Letter ID#: 1, 14, and 25)

*Comment:* NHFG supported our proposal to maintain Stubbs Pond Dam under alternative B in the draft CCP/EA because the pond “is unique in the Great Bay ecosystem for its size and value to waterfowl, marsh birds, and other wetland wildlife.” However, PREP recommends that the final CCP should include the removal of Stubbs Pond Dam and the restoration of the area to salt marsh habitat. In particular, they felt that:

- Stubbs Pond represents the largest remaining opportunity in Great Bay Estuary to reconnect historic salt marsh habitat to tidal flows.
- Restoring the pond would provide salt marsh habitat which is important for salt marsh sparrows, a rare focal bird species.
- Restoring the pond would “reconnect the marsh with a more natural tidal hydrology and enable dynamic natural processes to maintain quality wildlife habitat in the long term.”
- Restoring the pond would increase Great Bay Estuary’s resilience and adaptation to climate change by allowing marsh migration with sea level rise and will mitigate against salt marsh loss elsewhere in the estuary.
- It is unclear what analysis we used to reach our assertion that the loss of Stubbs Pond would have a major impact of freshwater birds (In particular, they stated that it was unclear if freshwater birds are “in a population status as precarious as salt marsh-dependent birds, such as salt marsh sparrows.” Additionally, they felt that the impact on American black ducks would likely be less than we predicted because the species also uses salt marsh habitat for breeding).
- Maintaining Stubbs Pond is costly and management-intensive.
- Removing Stubbs Pond Dam complements our proposal to remove Lower Peverly Pond Dam and will improve upstream and downstream fish passage.

*Response:* We thank NHFG for their support of our proposal to remove Lower Peverly Pond Dam (see Objective 1.3, “Freshwater Impoundments and Peverly Brook System in chapter 4 of the final CCP). We also appreciate PREP’s comments on Stubbs Pond and agree that salt marsh habitat and associated wildlife species are important priorities. However, we feel that, at this time, the value of Stubbs Pond as a freshwater wetland outweighs any potential benefit from restoring the area to salt marsh. We identify Stubbs Pond’s values as a freshwater wetland in the draft CCP/EA in chapter 2 (page 2-29) and chapter 3 (pages 3-42 to 3-44). We base our recommendation to maintain the pond on that information, which we summarize below:



- Stubbs Pond has been identified by NHFG and TNC as one of the most important freshwater wetlands in Great Bay. A large diversity of plants, and wildlife use Stubbs Pond, including species listed as threatened or special concern. It provides important habitat to numerous migratory waterfowl, including black ducks, with a species diversity not found elsewhere in Great Bay Estuary. Restoring the pond to salt marsh would reduce or eliminate use by many of the waterfowl and waterbird species currently present. For example, if we permanently breached Stubbs Pond, we would expect to see major reductions in use by American wigeon, wood ducks, ring necked ducks, ruddy ducks, common mergansers, and American coots. In our opinion, the loss of biological diversity in Stubbs Pond, including Federal trust species, is not warranted given the speculative nature of the restoration outcome.
- Great Bay Refuge is only 1,103 acres in size and cannot effectively provide habitat for every species. We have carefully considered what habitats and species will be our priorities on the refuge based on what we feel the refuge's greatest contributions to regional populations are. Appendix B, "Process for Establishing Refuge Focal Species and Priority Habitats," in the draft CCP/EA and final CCP explains the process we used to identify our priority species. Although restoring the pond to salt marsh may benefit a small number of refuge focal species, it would negatively impact many more. Therefore, we do not feel that restoring Stubbs Pond to salt marsh at this time is consistent with the priorities for the refuge and NHFG.
- The salt marsh sparrow is one of the highest priority species within our region. However, Great Bay Refuge has only a small amount of fringe salt marshes which is insignificant on a regional scale when considering the species. Under Goal 1, Objective 1.1, "Salt Marsh," we are planning to "collaborate with partners to assess the salt marsh sparrow population around the bay and determine the relative importance of the refuge population to the Great Bay ecosystem and to the larger regional population." We do agree that the species is at risk from potential sea level rise, but feel there is not enough evidence to suggest that restoring Stubbs Pond to salt marsh significantly contributes to gains in the regional population. We believe efforts for salt marsh sparrows in other New Hampshire estuaries will have greater benefits.
- We respectfully disagree that removing Stubbs Pond Dam and restoring the area to salt marsh would "greatly" improve passage for migratory fish and have a "net beneficial effect on diadromus fish." While taking out the dam may initially improve passage for migratory fish, eventually beaver will begin to dam the stream. Once the beaver dam the stream, it will be difficult for alewife and blueback herring to move upstream because they are not strong jumpers and beaver dams are generally impassable barriers to them. The removal of the dam would have very little impact on American eel passage because eel are currently able to reach Upper Peverly Pond, despite the three existing dams.

We also feel that removing Stubbs Pond could negatively impact spawning habitat for alewife. Alewife prefer impoundments and slow-moving water for spawning. Removing the Stubbs Pond impoundment will result in a significant loss of potential spawning habitat for alewife. Although beavers would eventually create pools and impoundments of slow moving water in the stream, the alewife would be unable to reach them since they have difficulty passing beaver dams. Removing Stubbs Pond Dam would also not provide blueback herring spawning habitat over the long term. Initially, the removal of Stubbs Pond would result in the faster moving water that blueback herring prefer for spawning, but again, beaver activity would eventually create small pools and impoundments of slow moving water.

After considering the potential short-term and long-term effects described in chapter 4 of the draft CCP/EA, we determine that removing Stubbs Pond Dam will not result in a long-term improvement in fish passage and will likely negatively impact alewife. Instead, we feel that maintaining the existing impoundment and fish ladder benefits the most species overall. We acknowledge that PREP, NHCP, and others have concerns about the effectiveness of our current fish ladder. Although we know that blueback herring and American eel are able to use the existing fish ladder, we are committed to ensuring that the ladder is effective as possible. As described under Objective 1.3, “Freshwater Impoundments and Peverly Brook System” in both the draft CCP/EA and final CCP, we plan to work with NHFG and the Service’s Central New England Fisheries Program to evaluate the effectiveness of the fish ladder and determine if there are practicable opportunities to enhance the movement of fish migrating through the ladder. If this evaluation recommends that the fish ladder be updated or repaired, we will implement those recommendations within 3 years of the review, and as funding allows (also see our response under “Fish Passage” below).

*Comment:* NHFG and NHCP commented on our proposed water level management in Stubbs Pond.

1. NHFG felt that the water level management in Stubbs Pond must be carefully designed to reduce conflicts between “potentially conflicting objectives.” They requested that refuge staff consult with their marine fishery and wildlife biologists “to discuss the frequency, timing, and extent of water drawdowns at Stubbs Pond.” In particular, they were concerned about water level management during the fall because, if poorly timed, it can impede their duck banding program on the refuge and can prevent muskrats and beavers from reaching their winter huts.
2. Also, both NHFG and the NHCP felt that we should coordinate the release of water from Stubbs Pond with the tide cycle to “ensure the success of emigrating fish species.”

*Response:*

1. We appreciate NHFG’s comment on Stubbs Pond water level management and agree that it can be very challenging to meet multiple objectives. Because of this, we do not intend to meet all of our subobjectives (outlined under Objective 1.3, “Freshwater Impoundments and Peverly Brook System” in chapter 4 of the final CCP) in any given year, but rather we hope to meet each subobjective over the 15-year period of the CCP.

We can also appreciate the challenges of waterfowl banding in or near managed impoundments. In recent years the abundance of natural foods at Stubbs Pond, such as wild rice, has made it more challenging to attract waterfowl for the banding program using bait.

In years when we conduct fall drawdowns, we do not do an entire drawdown within a short timeframe. We instead conduct drawdowns gradually to expose foods for migratory waterfowl throughout the fall migration, and then we bring water levels back up for winter.

2. Stubbs Pond has a constant outflow of water through both the fish ladder and water control structure because of the continuous flow of water into the pond from Peverly Brook. Since the tidal cycle changes daily, we feel it is logistically impractical for us to regulate the discharge of water from Stubbs Pond to coincide with high tide or to restrict discharge during the low tide cycle. This would require staff to be available to adjust the water level four times a day over a 24-hour period, 7 days a week. This would also cause a highly fluctuating water level within the impoundment and compromise our ability to achieve our specific habitat target for migratory waterfowl during the fall migration under Objective 1.3a, “Stubbs Pond” as described under alternative B in the draft CCP/EA and included in chapter 4 of the final CCP. Also, in our observations, fish are still able to emigrate out of Stubbs Pond during the fall under our water level management.

**Shrubland Habitat***(Letter ID#: 25)*

*Comment:* NHFG commented on our proposed shrubland management under alternative B in the draft CCP/EA. While they were very supportive of our proposal to increase shrubland habitat in the former Weapons Storage Area, they were “concerned about the loss of this habitat type outside of the [former Weapons Storage Area] as some grassland areas are allowed to revert to forest.” They recommended that we monitor and evaluate the grasslands areas south of the former weapons storage area and just north of Woodman Point as they revert, and consider maintaining them as shrubland if shrubland-dependent species appear to respond to the habitat. They stated that it was extremely important to maintain shrubland habitat on public lands because they are “transitional habitats that require continuing management to be sustained.” On private lands there is “no such assurance” of long-term ownership and active management.

*Response:* We appreciate NHFG’s comment and agree that shrubland habitats are important to many wildlife of conservation concern. Based on these comments, we have decided to add the following strategy under Objective 2.3, “Upland Shrubland,” in chapter 4 of the final CCP:

“Within 5 years of CCP approval, evaluate wildlife use and response in the 41 acres of grassland and shrubland we are allowing to naturally transition to forest. If these areas are providing regionally important habitat to shrubland-dependent species of conservation concern, evaluate whether the resources are available to actively manage these areas as shrubland, and adjust management accordingly, rather than allowing them to continue to transition to forest.”

**Rare Plants and Natural Communities***(Letter ID#: 13 and 25)*

*Comment:* We received several comments on rare plants and natural communities.

NHB stated that their ecologists identified several stands of red maple-elm-lady fern silt forest on Great Bay Refuge in 1999. This community type is very rare in New Hampshire and there are no records of “exemplary” occurrences of it in the State. Although the refuge’s stands have invasive species present, they felt the community type is rare enough that it should be a management priority for the refuge. They wrote that the “primary management activity in this community type would be invasive species control” and that “priority should be given to the largest patches that are also....surrounded by intact forest.”

NHFG asked us to add two plant species of conservation concern to table A.2 in appendix A of the draft CCP/EA: the blunt-leaved milkweed (State threatened) and golden heather (State endangered). They also requested that we discuss the importance of wild rice as wildlife food and cover in the final CCP. The species, which is uncommon in the State, was introduced to Stubbs Pond within the last few decades and is now “well established” and “abundant.”

*Response:* We have added additional information on the rare red maple-elm-lady fern silt forest natural community type to the section on “Habitat Types and Associated Wildlife” in chapter 3 of the final CCP. As described under Objective 2.2, “Forested and Scrub-Shrub Wetlands” in chapter 4 of the final CCP, we will continue to inventory and control for invasive species in rare natural communities on the refuge. We revised a strategy under this objective to state: “Inventory, map, and assess the quality of forested and scrub-shrub wetlands, including vernal pool habitat, rare plants, and rare natural communities. Identify actions that will sustain or enhance these areas, including treating invasive plants, as warranted.” We also added blunt-leaved milkweed and golden heather to table A.2 in appendix A of the final CCP. Finally, we added a few sentences about the importance of wild rice in Stubbs Pond to our discussion on “Freshwater Impoundments” in chapter 3 of the final CCP.

### **Fish Passage**

(Letter ID#: 1 and 25)

*Comment:* We received several comments on the fish ladder at Stubbs Pond from NHFG and NHCP. First, NHCP requested that we include a timeline in the final CCP for our proposal to evaluate the fish ladder and make any necessary improvements or repairs to improve fish passage. They also asked us to expedite both our evaluation and repairs.

Second, both NHFG and NHCP requested additional details about our proposed monitoring of the fish ladder, including how we will conduct the monitoring and how we will use the data gathered to make future management decisions. They also requested that any existing data we have about the type, number, and temporal distribution of fish using the fish ladder be included in our final CCP. Both agencies also asked when we would begin our monitoring program, and NHCP specifically recommended that we start to monitor water quality and quantity, migratory fish populations and their movements, and fish ladder operation and usage “immediately upon approval of the CCP.”

*Response:* Based on NHCP’s comments, we have amended our existing strategy on evaluating the Stubbs Pond fish ladder under Objective 1.3, “Freshwater Impoundments and Peverly Brook System” in chapter 4 of the final CCP. We added the following language to the strategy, “If this evaluation recommends that the fish ladder be updated or repaired, we will implement those recommendations within 3 years of the review, or as soon as funding allows.”

As far as existing data on use of the fish ladder, we have data from regular volunteer observations with specific dates of fish ladder use by blueback herring. Through several years of monitoring and operation of the fish ladder, we have observed that use of the fish ladder occurs in late spring, typically May through June, when blueback herring are migrating. We have not observed fish using the ladder during April, which is when we would expect alewife to be passing through. In addition, we do not have data on specific numbers of fish. We will continue to conduct this monitoring program. As for future monitoring of the fish ladder, we have identified monitoring components under Objective 1.3, “Freshwater Impoundments and Peverly Brook System” under alternative B in the draft CCP/EA and in chapter 4 of the final CCP. Our monitoring program will include volunteer monitoring of the fish ladder several times each week during the spring (April to mid-July) and weekly in the fall (September to November). We also added the following monitoring component in the final CCP: “Discuss the possibility of using automated monitoring with staff from the Service’s Fisheries Program.” Automated monitoring would allow us to get more accurate counts of fish.

We have also identified the need for monitoring with regard to water quality and quantity based on national standards under Objective 1.3, “Freshwater Impoundments and Peverly Brook System.” We did not include a timeframe for some of our monitoring components in the CCP because it is not clear at this time when we will receive adequate funding to support these activities. However, with partner assistance, we may be able to commit to monitoring much sooner. Our Habitat Management Plan and Inventory and Monitoring Plan will include greater details on the monitoring tools and techniques we will use, and the timing of our monitoring activities.

*Comment:* NHFG commented on our analysis of impacts to fish under alternative C in chapter 4 of in the draft CCP/EA. They pointed out that we discussed the short-term and long-term impacts of removing Stubbs Pond on alewife, but failed to discuss the impacts on blueback herring. They felt it would be more accurate to say that, over the short-term, “the removal of [Stubbs Pond Dam] would enhance passage for [alewife and blueback herring] and spawning habitat may become more favorable for blueback herring.”

*Response:* We acknowledge this information is accurate and should have been included in the draft CCP/EA, Chapter 4, “Environmental Consequences,” under the analysis of impacts to fish for alternative C. However, this information does not change our recommendation to continue to maintain Stubbs Pond Dam in the final CCP.

**Threatened and Endangered Species***(Letter ID#: 25)*

*Comment:* NHFG commented on our proposed management for the federally endangered Karner blue butterfly and the New England cottontail, a Federal candidate species. First, they were supportive of the refuge's proposal to have an "expanded involvement" in the recovery of the Karner Blue butterfly and are "looking forward to working with the refuge to implement the strategies [for the species] outlined in Alternative B." They also felt that the refuge "can have a significant role in conserving additional lands for the protection and management [of the Karner blue butterfly] in the identified focus area." Second, they urged us to "move ahead with [the New England cottontail captive rearing] initiative without delay."

*Response:* We greatly appreciate NHFG's continuing effort and support in helping to recover the Karner blue butterfly. Based on these comments, we realized that we did not emphasize enough the work that we are doing in partnership with NHFG to conserve this species in the draft CCP/EA. We have decided to change the name of the final CCP to "Great Bay National Wildlife Refuge and Karner Blue Butterfly Conservation Easement Comprehensive Conservation Plan" to raise the visibility of the easement for the butterfly and the important work being done on the easement with our partners to help recover this federally listed species.

We also appreciate NHFG's support for our proposal to create a New England cottontail captive rearing program, as described under Objective 2.3, "Upland Shrubland" in chapter 4 of the final CCP. We hope to finish constructing a hardening pen by the end of 2012, and will continue to work with partners to evaluate starting a captive rearing program on the refuge.

*Comment:* NHFG pointed out that we did not include rankings for several fish species in table A.1 of appendix A in the draft CCP/EA that are listed as federally threatened or considered Federal species of concern by the National Marine Fisheries Service (NMFS) and National Oceanic and Atmospheric Administration (NOAA). In particular, they stated that alewife, blueback herring, and rainbow smelt are species of concern and that the Atlantic sturgeon is federally threatened.

*Response:* We thank NHFG for pointing out our omission. We have updated table A.1, "Species and Habitats of Concern Known, or Potentially Occurring, on Great Bay Refuge and Karner Blue Butterfly Conservation Easement" in appendix A of the final CCP to include this information. We would also like to note that the Atlantic sturgeon (Gulf of Maine distinct population segment) was listed as federally threatened in February 2012, just after the release of the draft CCP/EA.

**Public Access and Use****Public Access and Public Use—General***(Letter ID#: 7, 10, and 25)*

*Comment:* We received three general comments on public use and access. One individual stated that he "really supports and enjoys" the current level of access on the refuge. Another individual and NHFG advocated opening up the refuge to greater public access. The individual wrote to, "strongly endorse increasing access to the area" and felt that "better public (taxpayer) access...would also help build local appreciation and support for...efforts on the refuge." NHFG stated that currently "most [of the refuge] is closed to the public" and felt that we would be unable to achieve goal 4, as described in the draft CCP/EA, "without greater public access to and interaction with the refuge." Although they recognized that without staff stationed at the refuge it would be difficult to greatly expand public access, they hoped "that eventually additional areas on the refuge, such as a Stubbs Pond overlook...can be developed to enhance public understanding...and support" of the refuge.



*Response:* We appreciate the desire for expanded public access to the refuge and agree that those opportunities may help build local support for the refuge. We are proposing expansions to our existing public use program under Objective 4.1, “Wildlife Observation and Photography,” Objective 4.2, “Environmental Education and Interpretation,” and Objective 4.3, “Hunting,” as described under alternative B in chapter 3 of the draft CCP/EA and in chapter 4 of the final CCP. We understand that some would like us to open new areas of the refuge. However, we believe our final CCP provides the level of public access that is commensurate with our highest priority to conserve and protect wildlife and their habitats and fulfill the purposes of the refuge. In addition, we feel this level of programming is reasonable and realistic for ensuring quality opportunities, given the levels of funding and staffing we expect for the foreseeable future. In response to the suggestion to provide an overlook of Stubbs Pond, under Objective 4.1, “Wildlife Observation and Photography,” we propose to construct a viewing platform on Fabyan Point within 10 years of CCP approval, assuming we can acquire a right-of-way, that there are not human safety concerns, and that it will not negatively impact wildlife. This proposed viewing platform would allow visitors to view Herods Cove and Stubbs Pond.

### **Hunting**

(Letter ID#: 10, 11, 12, and 25)

*Comment:* SPNHF, NHFG, and two individuals supported our proposal to evaluate expanding the refuge hunting program. One respondent supported expanding the refuge’s hunt program in general, while SPNHF commented on the importance of managing deer populations through hunting to prevent negative impacts to other biological resources.

Another individual specifically supported a fall bow deer hunt. He stated that he had experience with similar types of deer bow hunts, that these types of hunts are “good land conservation” and “work really well,” and offered to assist with the refuge’s proposed program.

NHFG supported both the proposed fall bow deer hunt and the wild turkey hunt. They felt that the refuge’s current hunt program is “very conservative” and “encourage[d] the refuge to consider additional days of firearms hunting for deer.” They also stated that they “are available to discuss the management of increased hunting access at the refuge.”

*Response:* We thank SPNHF, NHFG, and the other individuals for their support of our proposal to evaluate expanding the refuge hunting program to include a fall bow hunt for deer and a turkey hunt. For more information on our proposal, see Objective 4.3, “Hunting” under alternative B in chapter 3 of the draft CCP/EA, or in chapter 4 of the final CCP. We appreciate that many would like us to accelerate the proposed expansion of hunting opportunities on the refuge, but our administrative requirements and NEPA require a more thorough evaluation than we were able to conduct with this CCP. However, as we state under Objective 4.3, “Hunting,” we propose to conduct this evaluation within 3 years of CCP approval.

### **Environmental Education and Interpretation**

(Letter ID#: 7, 10, 17, and 22)

*Comment:* One individual “strongly endorse[d]...the development of educational opportunities within the refuge,” while another stated that he frequently uses the refuge as an educational resource. Another individual specifically requested that we develop interpretive and educational materials about important wildlife species and habitats in the region and make these available at the proposed visitor contact station. She specifically mentioned the following species and habitats: monarch butterflies, piping plovers, the Hampton/Seabrook Estuary, and the Audubon Society’s Important Bird Area.

*Response:* We agree that the refuge is a wonderful environmental education resource. We outline how we plan to improve and expand our environmental education program under Objectives 3.3, “Education and Outreach Partnerships” and 4.2, “Environmental Education and Interpretation” under alternative B in chapter 3 of the draft CCP/EA and in chapter 4 of the final CCP. We also plan to provide interpretive materials at the visitor contact station that relate to the species and habitat types that occur on the refuge. However, we would like to point out, that some of these enhancements depend upon having staff stationed at the refuge.

### **Bicycling**

*(Letter ID#: 5 and 21)*

*Comment:* We received two comments on bicycling. One individual “heartedly endorse[d]” our proposal to support community proposals to build a connector between a regional bike trail to the refuge’s entrance road. Another individual offered to volunteer his time and expertise to help build mountain bike trails near or around the refuge and Pease Tradeport. He stated that there were “a lot of already unused and uncared for trails [in the area] that would be perfect” and that the area was “clearly the best choice in [Portsmouth, New Hampshire,] for this property is large and wooded as well as unused.” He felt it was “unfair for hikers to have a designated trail and not bikers” and that a bike “trail a few miles long would suffice.” Additionally, he felt it important to have separate trails for bicyclers to reduce conflicts with hikers and walkers and said that “otherwise I see people using non-bike paths as there is nowhere else for them to ride their bike.”

*Response:* We appreciate the support for the proposed connection between the regional bike trail and the refuge’s entrance road, as described under the section on “Climate Change” in chapter 3 of the draft CCP/EA (page 3-5), and incorporated into chapter 4 of the final CCP. We have been advocates for a regional bike trail and hope that this connection will give visitors an alternative means of access to the refuge. In response to the suggestion to construct mountain bike trails on the refuge, we have determined that this is not an appropriate use for the refuge. Although we agree that having separate biking and hiking trails can reduce user conflicts, the disturbance from mountain biking to wildlife and habitats would be too great to allow this use on the refuge. Please see our finding of appropriateness for “Bicycling Off Public Entrance Road,” in appendix C in the draft CCP/EA for more information on why we feel bicycling on refuge trails is not appropriate.

### **Cultural Resources**

#### **Heritage and Cultural Resources**

*(Letter ID#: 24)*

*Comment:* NDHR commented on cultural, historic, and archaeological resources. They reviewed the draft CCP/EA and determined that it was “thorough and comprehensive” with regards to cultural resources. They stated that many areas of the refuge are “considered archaeologically sensitive” and have the potential to contain Native American sites or early historic sites. They felt that some of our proposed habitat management, public use, trail enhancements, and other ground-disturbing activities have the potential to directly or indirectly impact historic and cultural resources on the refuge. They requested that we continue to consult with them to help protect these resources.

*Response:* We take our responsibility to protect historic and cultural resources very seriously. We will continue to consult with them as we implement specific projects outlined in chapter 4 of the final CCP, particularly those that include ground-disturbing activities or have the potential to directly or indirectly impact historic and cultural resources.

**Table K.1. Letter ID Numbers and Respondents**

<b>Letter ID Number</b>	<b>Name or Organization</b>
1, 8	New Hampshire Department of Environmental Services, New Hampshire Coastal Program (Christian Williams)
2	New Hampshire Division of Historic Resources (Edna Feighner)
3	Herb Lobsenz
4	Ward Feurt
5	Brian Giles
6	Jane Hislop
7	Justin Richardson
9	Newington Conservation Commission (Justin Richardson)
10	Charles H. Williams
11	Robert C. Lang
12	Society for the Protection of New Hampshire Forests (Paul Doscher)
13	New Hampshire Natural Heritage Bureau (Pete Bowman)
14	Piscataqua Region Estuaries Partnership (Derek Sowers)
15	Great Bay Resource Protection Partnership (Dea Brickner-Wood)
16	The Nature Conservancy (Doug Bechtel)
17, 22	Gayle Sweeney
18	Defenders of Wildlife (Julie Kates)
19	Charlie and Cheryl Lawrence
20	Deborah Carey
21	Nathaniel (no last name given; email correspondence)
23	U.S. Environmental Protection Agency (Jean Brochi)
24	New Hampshire Division of Historical Resources (Richard Boisvert)
25	New Hampshire Fish and Game (Glenn Normandeau)

## Appendix L



*Wood duck*

## Finding of No Significant Impact (FONSI)

## **Finding of No Significant Impact (FONSI) Great Bay National Wildlife Refuge Comprehensive Conservation Plan**

In February 2012, the U.S. Fish and Wildlife Service (Service, we, our) published the draft Comprehensive Conservation Plan and Environmental Assessment (CCP/EA) for Great Bay National Wildlife Refuge (Great Bay Refuge, the refuge). Great Bay Refuge was established in 1992 when lands from the former Pease Air Force Base were transferred to the Service. The 1,103-acre refuge is located in the town of Newington, New Hampshire. The refuge's forested, wetland, shrubland, and grassland habitats support a wide diversity of waterfowl and waterbirds, shorebirds, landbirds, and other native wildlife species of conservation concern. Great Bay Refuge also includes the Karner blue butterfly conservation easement in the city of Concord, New Hampshire. The 29-acre conservation easement is part of a fragmented, but important, complex of remnant pine barrens that supports rare moths and butterflies and is managed specifically for the federally endangered Karner blue butterfly. Great Bay Refuge and the Karner blue butterfly conservation easement are administered by Parker River Refuge located in Newburyport, Massachusetts.

Chapter 1 of the draft CCP/EA identifies the purpose of, and need for, a CCP and summarizes the laws, policies, and other mandates we follow in developing the plan. It describes international, national, and regional conservation plans that were used as references, and defines our project analysis area. Chapter 1 also presents the refuge's purposes, and describes the vision and goals we set for the refuge over the next 15 years. Finally, chapter 1 describes the planning process, including public and partner involvement, and the issues and concerns that are addressed in the plan. Chapter 2 describes the current physical, biological, and socioeconomic environments of the refuge, as well as its surroundings. Chapter 3 describes three proposed management alternatives for the refuge. The alternatives include a detailed description of their respective objectives and strategies designed to help achieve refuge purposes, vision, and goals, and contribute to the mission of the National Wildlife Refuge System (Refuge System). We identified alternative B as the Service-preferred alternative. Chapter 4 carefully considers and evaluates each alternative's direct, indirect, and cumulative impacts on the environment. Chapter 5 includes a listing of who we consulted and coordinated with during development of the plan, and includes a list of document preparers.

The draft plan's 10 appendixes provide additional information supporting the assessment and specific proposals in the Service-preferred alternative. A brief overview of each alternative follows.

### **Management Alternatives**

Alternative A (Current Management): Alternative A satisfies the National Environmental Policy Act of 1969 (NEPA) requirement of a "no action" alternative, which we define as "continuing current management." It describes our existing management priorities and activities for Great Bay Refuge and Karner blue butterfly conservation easement, and serves as a baseline for comparing and contrasting alternatives B and C.

Alternative B (Habitat Diversity and Focal Species Emphasis): Alternative B is the Service-preferred alternative. It combines the actions we believe would best achieve the refuge's purposes, vision, and goals, and respond to public issues. Under alternative B, we would emphasize the management of specific refuge habitats to support focal species whose habitat needs also benefit other species of conservation concern that are found in the Great Bay region. In particular, we would focus on providing habitat for priority migratory birds, such as waterfowl, waterbirds, shorebirds, and forest-interior landbirds; for rare and declining species, such as the New England cottontail and tree bats; and for estuarine and aquatic species of concern, including shellfish and migratory fish. We propose removing the Lower Peverly Pond Dam to restore stream habitat to benefit migratory fish, while maintaining the dams at Upper Peverly Pond and Stubbs Pond to benefit a range of fish and wildlife. We would expand our conservation, research, and management partnerships to help restore and conserve the Great Bay Estuary ecosystem. This alternative would enhance our visitor services programs by improving the main access to the refuge, creating new interpretive materials, expanding our existing volunteer program, and offering visitors more opportunities to learn about the refuge and the surrounding landscape. On the Karner blue butterfly conservation easement, we would continue to maintain habitat to support recovery of this species. We would enhance interpretive opportunities by installing new interpretive signs, offering guided interpretive walks, and enhancing our Web-based information.



**Alternative C (Emphasis on Natural Processes):** Alternative C would rely primarily on ecosystem processes and natural disturbances to restore the biological integrity, diversity, and ecological health of Great Bay Refuge. All grassland and shrubland habitat on the refuge would be allowed to naturally transition to forest. All three refuge impoundments would be removed, restoring Peverly Brook to stream habitat and returning Stubbs Pond to salt marsh to the extent practicable. Under this alternative, we would expand the refuge visitor services program and allow public pedestrian access to areas of the refuge previously closed. For example, we would construct two new trails. Also, as sensitive shrubland and grassland habitats transition to forest, we would open those areas to public use. The management of the Karner blue butterfly conservation easement would be the same as that proposed under alternative B.

### **Selection of Management Alternative for the Final CCP**

We distributed the draft CCP/EA for a 39-day period of public review and comment from February 10, 2012, to March 19, 2012. We received 25 written responses representing individuals, organizations, and Federal, State, and local agencies. Appendix K in the final CCP includes a summary of those comments and our responses to them. After reviewing the proposed management actions, and considering all public comments and our responses to them, I have determined that the analysis in the EA is sufficient to support my findings. I am selecting alternative B, as presented in the draft CCP/EA, with the following modifications listed below, to implement as the final CCP:

- We added a strategy under objective 2.3 that states: “Within 5 years, evaluate wildlife use and response in the 41 acres of grassland and shrubland we are allowing to naturally transition to forest. If these areas are providing regionally important habitat to shrubland-dependent species of conservation concern, evaluate whether the resources are available to actively manage these areas as shrubland, and adjust management accordingly, rather than allowing them to continue to transition to forest.”
- We added a strategy under objective 1.3 that states: “Within 3 years of CCP approval, work with partners to detect and remove “hot spots” of DDT contamination in Upper Peverly Pond, if determined feasible, and contingent upon funding and staffing.”
- We edited an existing strategy on evaluating the Stubbs Pond fish ladder under objective 1.3 to say: “If this evaluation recommends that the fish ladder be updated or repaired, we will implement those recommendations within 3 years of the review, or as soon as funding allows.”
- We revised an existing strategy under objective 2.2 to state: “Inventory, map, and assess the quality of forested and scrub-shrub wetlands, including vernal pool habitat, rare plants, and rare natural communities. Identify actions that will sustain or enhance these areas, including treating invasive plants, as warranted.”
- We also corrected all formatting and typographical errors that were brought to our attention.

I concur that alternative B, with the above changes, and in comparison to the other alternatives, will best:

- Fulfill the mission of the Refuge System.
- Achieve the refuge’s purposes, visions, and goals.
- Maintain and, where appropriate, restore the refuge’s ecological integrity.
- Address the major issues identified during the planning process.
- Ensure consistency with the principles of sound fish and wildlife management.

Specifically, in comparison to the other two alternatives, alternative B provides the best balance in sustaining or improving the biological integrity, diversity, and environmental health of the refuge. Compared to alternative C, alternative B would provide a wider diversity of habitat types, since it maintains some grassland, shrubland, and freshwater impoundments. Because alternative B has a greater level of habitat diversity than alternative C, alternative B supports a wider range of species of conservation concern, including the State-listed upland sandpiper, the Federal candidate New England cottontail, and wintering migrating waterfowl. In comparison to alternative A, alternative B would increase the biological integrity of the refuge by reducing habitat fragmentation by consolidating grassland and shrubland fields into larger, more effective blocks of habitat, and by removing Lower Peverly Pond Dam and restoring approximately 1,100 feet to native stream habitat.

Alternative B also offers the best opportunity to enhance and expand recreational opportunities, while still maintaining a diversity of habitats and protecting sensitive wildlife areas from disturbance. Compared to alternative A, alternative B would expand the refuge's visitor services program by improving and adding trails, adding interpretive panels, and offering guided interpretive walks. An expanded hunt program would also be evaluated, including opportunities for a turkey hunt and fall bow season for deer. Although alternative C would open a larger portion of the refuge to public access than alternative B, the quality of wildlife observation and photography opportunities would likely be impacted. Under alternative C, the refuge would primarily become forest which would affect mid- and long-range viewing opportunities, in comparison to the longer views afforded by the mix of grassland and shrubland habitats under alternative B.

Finally, the plans to increase staffing and develop a new visitor contact station/refuge headquarters under alternative B are reasonable, practicable, would result in the most efficient management of the refuge, and would best serve the American public by providing quality interpretive and outreach opportunities.

This Finding of No Significant Impact includes the EA and its analysis by reference. I have reviewed the predicted beneficial and adverse impacts associated with alternative B that are presented in chapter 4 of the draft CCP/EA, and compared them to the other alternatives. I specifically reviewed the context and intensity of those predicted impacts over the short and long term, and considered cumulative effects. Socioeconomic, natural resources, cultural resources, and visitor impacts would generally be positive or result in negligible adverse impacts over the long term. My review of each of the NEPA factors to consider in assessing whether there will be significant environmental effects is summarized here (40 C.F.R. 1508.27).

Beneficial and adverse effects—We expect the management actions in the final CCP to provide far more substantial benefits to the natural and human environment than it will cause adverse effects. Important benefits include the following:

- Improved biological integrity, diversity, and environmental health from controlling invasive species and consolidating forested, grassland, and shrubland habitat into larger, contiguous blocks reducing edge effect and fragmentation.
- Protection of regionally important habitats, including estuarine habitats, rocky shoreline, salt marsh, and Stubbs Pond, the largest freshwater impoundment in the region.
- Conservation of rare, threatened, and endangered species including the federally endangered Karner blue butterfly and the Federal candidate New England cottontail.
- Removal of Lower Peverly Pond Dam and restoration of 1,100 feet of stream habitat to benefit migratory fish and restore this reach of stream to more natural hydrology.
- Expanded, high-quality public use opportunities.

We anticipate minor adverse effects from habitat management activities, maintenance of buildings and public use facilities, demolishing and removing old building and facilities that are no longer in use, and from visitors engaged in wildlife-dependent recreation. Most of these effects would be incremental in their impacts, as they do not represent any major changes to current management. We also anticipate negligible, short-term impacts from construction of a new, energy-efficient visitor contact station/refuge headquarters building. In order to reduce the likelihood of causing adverse impacts we would:

- Allow only compatible and appropriate public uses and limit visitors to designated areas and trails.
- Use energy-efficient practices and vehicles, whenever possible.
- Use best management practices for habitat management and the construction and maintenance of facilities.

Given these considerations, there should be no significant impacts on the natural and human environment from the implementation of the CCP.

Public health and safety—We expect the refuge's good safety record to continue under the final CCP. Public health and safety is a paramount consideration in designing and implementing all activities on the refuge, whether those activities support habitat or visitor services programs. Adherence to spill prevention plans, pesticide use plans, best management practices, and the protective actions provided in the stipulations of the compatibility determinations for authorized public uses on the refuge, will be a priority. Given these considerations, there should be no significant impact on public health and safety from the implementation of the CCP.

Unique characteristics of the area—We expect the unique and regionally significant character of the refuge and conservation easement to be maintained under implementation of the final CCP. These unique characteristics include the following:

- The 1,103-acre refuge is the largest parcel of protected land on Great Bay Estuary.
- The 44-acre Stubbs Pond is regionally unique because it is one of the largest freshwater impoundments in the Great Bay area, supports the greatest diversity of waterfowl found in coastal New Hampshire, and supports wild rice, a rare and important source of food and cover for wildlife.
- The refuge supports numerous rare, threatened, and endangered fish, wildlife, and plant species, as well as five exemplary natural communities.

We expect the management actions outlined in the CCP would continue to protect these unique characteristics. These actions include the following:

- Maintaining and managing Stubbs Pond impoundment.
- Managing forested, grassland, and shrubland habitats to benefit species of concern.
- Prohibiting public access to sensitive estuarine, grassland, and shrubland habitats.
- Evaluating land protection focus areas.

Given these considerations, there should be no significant impact on the unique characteristics of the area due to implementation of the CCP.

Highly controversial effects—We do not predict that any highly controversial effects would occur from implementing the final CCP. We have extensive experience protecting rare, threatened, and endangered species; conducting forest, shrubland, and grassland habitat management; managing freshwater impoundments, controlling invasive plants and pests, controlling deer populations through hunting, and other activities to support wildlife-dependent recreational uses. The effects of these actions are widely known from our past management and monitoring. There is no scientific controversy over what these effects will be. Given these considerations, there is little risk of any unexpected, highly controversial effects on the quality of the human environment.

Highly uncertain effects or unknown risks—We do not predict any highly uncertain effects or unknown risks with implementing the final CCP. The management actions in the final CCP are mostly refinements of existing management that we have used since the refuge and conservation easement were established. However, there is the potential for some small amount of uncertainty with the following two management actions: 1) removing Lower Peverly Pond Dam and restoring approximately 1,100 feet to native stream habitat, and 2) starting a captive rearing program for New England cottontail. In addition, there is some uncertainty with regard to how climate change will impact refuge resources.

The possible uncertain effects or unknown risks from removing Lower Peverly Pond Dam may include the following:

- Lower Peverly Pond Dam has been in place for several decades. During this time, the hydrology of the area has been highly altered and sediments have collected in the impoundment. Removing the dam will release some of these sediments and will change the hydrology of the area. Our objective is to restore it back to native stream habitat, but we cannot predict how quickly and effectively this will occur.

- The existing Lower Peverly Pond impoundment may contain aquatic invasive species and contaminated sediments that are not known at this time. Removing the dam prior to addressing these issues may result in the spread of invasive species and contamination downstream.
- We have not yet finalized our design for removing the dam and restoring the area to native stream habitat. Our objective is to work with experts within and outside the Service to evaluate the characteristics of the stream habitat (e.g., stream substrate, water depth, and water speed), and develop a design to benefit our focal species and habitats. However, at this time, there is still some level of uncertainty with regards to how effective it will be.

We feel that the benefits of removing Lower Peverly Pond Dam and restoring the area to stream habitat far outweigh the potentially uncertain impacts and risks. Lower Peverly Pond Dam is currently in poor condition and continues to deteriorate. Without intervention, the dam will eventually fail. By working with experts to carefully design the dam removal and subsequent habitat restoration, we would have greater control over the type of habitat that is created, the species that benefit, and the new stream's hydrology. We would mitigate against the potential for uncertain effects and risks by controlling invasive species, and assessing and removing sediment contamination, prior to removing the dam. We would also assess the current habitat condition of the impoundment and then monitor the change in vegetation after dam removal.

The possible uncertain effects or unknown risks from starting a captive rearing program for New England cottontail may include the following:

- There are currently no New England cottontail rabbits on the refuge, and therefore, we would be introducing an extirpated species to the refuge.
- We cannot be certain that the program will be successful, as captive rearing of this species is a relatively new program.

We feel the potential of this project to benefit the New England cottontail, which is a Federal candidate species, far outweighs the small potential for uncertain impacts or unknown risks. We will try to mitigate for these potential effects and risks by consulting and working with experts in New England cottontail captive rearing, following agreed upon protocols established by those experts for introducing the rabbits into fenced-in outdoor pens, and continually monitoring the program to see if it is successful and should continue.

There are many predictions of climate change impacts, but all have a degree of uncertainty. Generally, on a broad scale, it is predicted that the greatest effects of climate change will be on regional air and water temperatures, precipitation patterns, storm intensity, and sea levels, although the degree to which those changes will occur varies among climate change models. Those broad scale changes are anticipated to influence natural disturbances patterns and result in a decrease in freeze periods, decreased snow cover, increased storm intensities and frequencies, increased intensity and frequency of summer droughts, damaging ozone, and an increase in the spread of invasive species and disease. The resulting effects on wildlife and habitats are expected to be variable and species-specific. There are no site-specific models for the refuge.

We feel the final CCP adheres to the main guiding principal of the Service's climate change adaptation planning which is to establish baseline conditions and monitor changes to those conditions, through the inventory and monitoring strategies we have identified, and by maintaining or increasing the resiliency of the refuge's habitats and ecological processes through forest, aquatic, and shoreline restoration activities. We are also safeguarding against the uncertainty and unpredictability of future climate change effects by using an adaptive management approach.

Despite the potential for some small amount of uncertainty from these the two management actions and climate change impacts, we do not find a high degree of uncertainty or unknown risk that the final CCP will cause any significant direct, indirect, or cumulative impact on the environment. This conclusion is based on available data about the impacts of our current management actions, and our use of education, monitoring, expert consultations, outreach, and enforcement to help identify and address any unplanned effects.



Precedent for future actions with significant effects—We developed actions and strategies to support the purpose of the CCP, which is to develop a strategic management plan to best meet the refuge’s purposes and goals, and the Refuge System mission for up to 15 years. The effects of management are designed as gradual improvements over the existing conditions, not global or expansive changes. For example, strategies, such as controlling invasive plants and working with others to improve water quality in Great Bay Estuary, and removing one of three dams on Peverly Brook, provide small incremental gains with impacts that may take several years to realize any benefits. Given these considerations, we do not expect the actions in the final CCP to set a precedent for future actions that may cause any significant impact on the environment.

Cumulatively significant impacts—We do not predict that any cumulatively significant impacts would result from implementing the final CCP based on our NEPA analysis that accompanies the draft CCP/EA. However, since the CCP provides 15-year strategic direction for the refuge, there are actions that provide some cumulative benefits to the Great Bay Estuary region when considered along with other past, present, or reasonably foreseeable future actions on or in the vicinity of the refuge. For example, we plan to continue to coordinate with surrounding land managers to promote common goals, such as improving water quality in Great Bay Estuary, providing wildlife-dependent recreational uses, and conducting research. Our participation in established partnerships, such as Piscataqua Region Estuaries Partnership, Great Bay National Estuarine Research Reserve, and Great Bay Resource Protection Partnership, will also promote long-term protection of Great Bay resources. Given these considerations, we do not foresee any of these coordinated activities rising to the level of a significant cumulative effect on the environment.

Effects on scientific, cultural, or historical resources—We have developed actions that would improve our knowledge and understanding of the refuge’s resources through scientific investigations, as well as benefit the refuge’s archaeological, historical, and cultural resources. Goal 3 in the final CCP specifically identifies research partnerships to maintain or initiate. Goals 1 and 2 also list strategies for conducting compatible research, and inventory and monitoring projects in support of refuge goals and objectives. With regards to cultural and historic resources, we submitted our plan for review by the New Hampshire State Historic Preservation Officer who concurred that alternative B complies with section 106 of the National Historic Preservation Act. We would continue to consult with the Service’s regional archaeologist and the New Hampshire State Historic Preservation Officer to ensure compliance with Federal and State cultural resource laws as we implement ground disturbing activities. Although there would be some risk that visitors could damage or disturb cultural resources on the refuge and easement, these risks would be reduced by limiting public access to designated trails and areas only. We would couple that protection with increased outreach, education, and interpretation of those resources and the importance of conserving them. Given these considerations, we do not anticipate any significant effects on scientific, cultural, or historical resources.

Effects on Endangered Species Act (ESA)-listed species and habitats—We have completed a consultation with the Service’s Ecological Services Field Office under section 7 of the ESA. Their endangered species specialists have concurred that the actions planned in the final CCP are not likely to adversely affect any ESA-listed species. The only federally threatened or endangered species that occurs on the refuge is the Karner blue butterfly, which only occurs on the Karner blue butterfly conservation easement.

No other federally listed species currently occurs on either the conservation easement or Great Bay Refuge. However, several candidate species occur, or may occur in the future, on the refuge and another listed species occurs near the refuge. River herring (alewife and blueback herring), a Federal candidate species, currently occurs on the refuge and in Great Bay Estuary. We are also evaluating starting a captive rearing program for New England cottontail, a Federal candidate species, on the refuge. Finally, the federally threatened Atlantic sturgeon occurs in Great Bay Estuary, but off of the refuge.

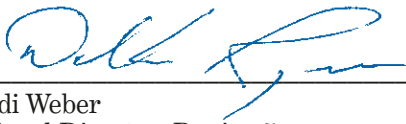
We have designed our management activities to benefit and reduce the potential to adversely impact to all of these species. For example, we would enhance our partnership with New Hampshire Fish and Game to actively manage for Karner blue butterflies on the conservation easement. Also, we will expand the amount of shrubland habitat at Great Bay Refuge to benefit New England cottontail and support a captive rearing program for the species. Additionally, we will maintain Stubbs Pond and restore 1,100-foot stretch of native stream habitat for migratory fish, including alewife and blueback herring. Finally, we would work with partners to increase water quality in Great Bay Estuary to benefit numerous estuarine species, including the Atlantic sturgeon. Given these considerations, we do not anticipate any significant effects on these ESA-listed resources.



Threat of violating any environmental law—Our habitat management actions are designed to benefit the environment. They will comply with all applicable laws, such as the Clean Water Act, the Clean Air Act, Coastal Zone Management Act, ESA, and the National Historic Preservation Act. We have specifically consulted with the State's Historic Preservation Office and Coastal Program Office to obtain concurrence that our actions are consistent with the National Historic Preservation Act and Coastal Zone Management Act, respectively. We have obtained concurrence on ESA compliance through our New England Field Office. Our existing and proposed public hunting opportunities will be consistent with State regulations. Given these considerations, we do not anticipate a threat that the CCP will violate any environmental law or cause any significant impact on the environment.

Based on this review, I find that implementing alternative B will not have a significant impact on the quality of the human environment in accordance with Section 102(2)(c) of NEPA. Therefore, I have concluded that this Finding of No Significant Impact is appropriate and an Environmental Impact Statement is not required.

**ACTING**



Wendi Weber  
Regional Director, Region 5  
U.S. Fish and Wildlife Service  
Hadley, Massachusetts

*29 Aug 2012*

Date

**Great Bay National Wildlife Refuge**  
**c/o Parker River National Wildlife Refuge**  
**6 Plum Island Turnpike**  
**Newburyport, MA 01950**  
**Phone: 978/465 5753**  
**<http://www.fws.gov/northeast/greatbay/>**

**Federal Relay Service**  
**for the deaf or hard of hearing**  
**1 800/877 8339**

**U.S. Fish & Wildlife Service**  
**<http://www.fws.gov>**

**For Refuge Information**  
**1 800/344 WILD**

**August 2012**

